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Report No. CG-D-20-92



## AN INVESTIGATION OF THE IMO SPREAD OF FLAME TEST METHOD

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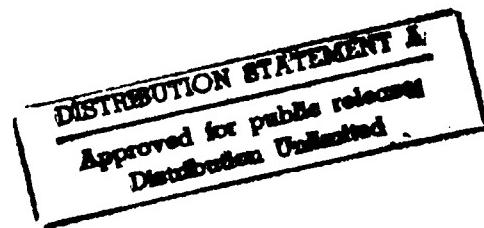
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## Technical Report Documentation Page

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16. Abstract  International Maritime Organization (IMO) A.564(14) tests were made on a selection of interior finish materials acceptable for use in maritime applications by the U.S. Coast Guard. The results of these tests were compared to ASTM E-84 Flame Spread Index values for the same materials. Limiting values for pass/fail criteria were estimated based on these comparisons.			
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# METRIC CONVERSION FACTORS

## Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
			<u>LENGTH</u>	
in	inches	* 2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
			<u>AREA</u>	
	square inches	6.5	square centimeters	cm <sup>2</sup>
	square feet	0.09	square meters	m <sup>2</sup>
	square yards	0.8	square meters	m <sup>2</sup>
	square miles	2.6	square kilometers	km <sup>2</sup>
	acres	0.4	hectares	ha
			<u>MASS (WEIGHT)</u>	
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
			<u>VOLUME</u>	
	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	liters	l
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	cubic meters	m <sup>3</sup>
ft <sup>3</sup>	cubic feet	0.03	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.76	cubic meters	m <sup>3</sup>
			<u>TEMPERATURE (EXACT)</u>	
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

## Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
			<u>LENGTH</u>	
in	millimeters	0.04	inches	in
in	centimeters	0.4	inches	in
ft	meters	3.3	feet	ft
yd	meters	1.1	yards	yd
mi	kilometers	0.6	miles	mi
			<u>AREA</u>	
	square centimeters	0.16	square inches	in <sup>2</sup>
	square meters	1.2	square yards	yd <sup>2</sup>
	square kilometers	0.4	square miles	mi <sup>2</sup>
	hectares (10,000 m <sup>2</sup> )	2.5	acres	acres
			<u>MASS (WEIGHT)</u>	
oz	grams	0.035	ounces	oz
lb	kilograms	2.2	pounds	lb
	tonnes (1000 kg)	1.1	short tons	lb
			<u>VOLUME</u>	
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	0.125	cups	c
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
m <sup>3</sup>	cubic meters	0.26	gallons	gal
m <sup>3</sup>	cubic meters	35	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.3	cubic yards	yd <sup>3</sup>
			<u>TEMPERATURE (EXACT)</u>	
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
°F				

\* 1 in = 2.54 (exactly).

FORWARD

This report was prepared by the Marine Fire and Safety Research Branch, Avery Point, Groton, CT. The project number assigned for this work was 3308.08.47

This report outlines the results of a project designed to evaluate the IMO spread of flame test method. Experimental work using the IMO spread of flame test apparatus was conducted by Coast Guard personnel at the Center for Fire Research, National Bureau of Standards, Gaithersburg, MD.

Mr. Klaus Wahle was program manager for this project. Important contributions to this work were made by Dr. Alex Robertson and Margaret Harkelroad from NBS, and Mr. Carl Hafer and Mrs. Barbara Dean of Southwest Research Institute, San Antonio, Texas. The work could not have been accomplished without the assistance and editing of Ms. D. Baird and Ms. M.E. Mahoney. DDC N. Niedringhaus, U.S. Coast Guard Fire and Safety Test Detachment, Mobile, AL, conducted the tests and recorded his observations.

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## **1.0 EXECUTIVE SUMMARY**

Spread of flame tests were made on selected bulkhead finish materials to assist in the development of pass/fail criteria for the "derived fire characteristics" determined by the test procedures specified in Resolution A.564(14) by the International Maritime Organization assembly. Data from these tests were compared to data for the same materials using the ASTM E-84 test method. The ASTM E-84 test is the national test specified by the U.S. Coast Guard Regulations for interior finish materials. An analysis was made in order to establish the relationships between the two test methods. The results of this analysis suggested appropriate limiting values for the derived fire characteristics as follows: Critical Flux at Extinction (CFE) and Heat for Sustained Burning (HSB) of  $30 \text{ kW/m}^2$  and  $3 \text{ MJ/m}^2$ , respectively. These values are somewhat higher than those recommended by the Ad Hoc Working Group of the Subcommittee on Fire Protection. In addition, similar data was obtained for other derived fire characteristics: Heat for Ignition, Total Heat Release and Maximum Rate of Heat Release. Comparative tests were conducted by Underwriters Laboratories (U.L.) using the same materials in order to obtain an assessment of the reproducibility of that test method.

## **2.0 INTRODUCTION**

### **2.1 OBJECTIVES**

The overall objective of this project was to establish pass/fail criteria for the IMO A.564(14) test method based on a comparison of the relationships between ASTM E-84 and IMO A.564(14) test results for selected bulkhead finish materials. The specific technical objective was to obtain sufficient data to be able to develop a suitable basis for formulating correlation plots which would outline the relationships between the "derived fire characteristics" specified by the IMO test method and the Flame Spread Index (FSI) specified by the ASTM E-84 test procedure. The derived fire characteristics of major concern were the

Critical Flux at Extinction and Heat for Sustained Burning. Derived fire characteristics of secondary concern were Heat for Ignition, Maximum Rate of Heat Release, and Total Heat Release.

## 2.2 BACKGROUND

Recognizing the need to improve test procedures required to determine the term "low flame spread" in regulations II-2/3.8, II-2.34.3, and II-2/49.1 of the International Convention for the Safety of Life at Sea, 1974 as amended, the Assembly at the 14th session of the IMO adopted Resolution A.564(14) entitled "REVISED RECOMMENDATION ON FIRE TEST PROCEDURES FOR SURFACE FLAMMABILITY OF BULKHEAD AND DECK FINISH MATERIALS." This recommendation specifies a procedure for measuring the fire characteristics of bulkhead and deck finish materials as a basis for characterizing their flammability and thus their suitability for use in marine construction. In addition the Assembly recommended that the Governments concerned apply this recommendation in conjunction with the guidelines set out in resolution A.166 (ES.IV) on the evaluation of fire hazard properties. These guidelines require: (1) that in evaluating the flame-spread of material, Administrations should employ the national test method commonly used for building materials provided the procedure is considered capable of providing information on the behavior of surfaces under fire conditions which may be met in actual fire aboard ship; and (2), that only materials which demonstrate good performance according to national classification should be considered to satisfy the property of "low flame-spread" for shipboard use. However, Resolution A.564(14) did not specify pass/fail criteria to be used in conjunction with the procedures outlined in the Recommendation. The Ad-Hoc Working Group of the Sub-Committee on Fire Protection has considered this problem during its 31st and 32nd sessions. Proposed limits for acceptability of lining materials of reduced flammability were agreed upon in report FP 31/WP.4, Annex 1. Limits were prescribed for three defined fire properties: Heat of Ignition, Heat for Sustained Burning, and Critical Flux at Extinguishment.

Subsequently, these limits and properties were revised in Report FP 32/WP.9, Annex 1. The requirement for Heat of Ignition was discontinued and the limiting values for Critical Flux at Extinguishment and Heat for Sustained Burning were prescribed at greater than or equal to  $20.0 \text{ kW/m}^2$  and  $2.0 \text{ MJ/m}^2$ , respectively. Finally, the group considered that before a firm proposal to adopt specific performance limits for heat release was submitted to the Sub-Committee, it was essential to have a more comprehensive review of the performance of a range of products. An experimental project was designed to provide information regarding the performance of typical materials currently accepted by the U.S. Coast Guard for marine use when tested using the national test used in the United States for building materials and the procedures outlined in the resolution and by the working group. The results of this project are outlined in the following sections.

### 2.3 TECHNICAL APPROACH

Experimental tests were conducted to establish relationships between the "derived fire characteristics" evaluated by the IMO Spread of Flame Test Method and the ASTM E-84 Spread of Flame Index used by the U.S. Coast Guard to accept bulkhead finish materials. The tests were divided into three test series. Part 1 outlined correlations between the test methods for ten (10) materials currently accepted for use by the U.S. Coast Guard. In accordance with current U.S. test practices the materials were applied to Glass Reinforced Cement (GRC) board. Part 2 outlined correlations for the same materials applied to Marinite for the IMO tests. Part 3 investigated the relationships for nine (9) additional materials which were estimated to have ASTM E-84 flame spread index ratings not acceptable by current U.S. Coast Guard regulations. These nine materials were applied to Marinite for both the IMO A.564(14) and the ASTM E-84 tests. The ten materials chosen for Part 1 and Part 2 tests were divided into three major material types: (1) composite laminates; (2) coatings; and (3); pvc decorative films.

Three materials representative of each type was chosen for evaluation. In addition a specialized glass net reinforced finish was tested. Test results were analyzed using a correlation analysis. In this analysis each of the "derived fire characteristic" parameters was plotted against the "spread of flame index". The form of the curve provides an indication of the degree of dependence of the "derived fire characteristic" parameters measured by the IMO test on the values of the ASTM E-84 spread of flame index for the types of materials tested. To the extent that these dependencies can be evaluated, this approach provides a rational technical basis for establishing relative limits on material flammability in accordance with established national fire test requirements.

### **3.0 EXPERIMENTAL**

#### **3.1 GENERAL**

The project was divided into four parts. Part 1 involved a comparative study of U.S. Coast Guard approved materials. Because the Coast Guard approvals were based on ASTM E-84 test results in which the materials had been mounted onto glass reinforced cement (GRC) board the IMO test specimens were mounted on this substrate. Part 2 investigated the same materials mounted on a marine board Marinite I. Part 3 extended the data to materials and/or application rates not currently accepted by the Coast Guard. Part 4 provided an assessment of the reproducibility of the test method based on a comparison of test results obtained by the U.S. Coast Guard and Underwriters Laboratories for selected samples. The test materials were mounted on the substrate using the adhesives recommended by the manufacturer. No attempt was made to optimize the effectiveness of the bonding procedures resulting from the change of substrate from GRC to Marinite I board. Based on a review of currently accepted materials the selected materials were divided into three major classes: (1) laminates, (2) paints and coatings, (3) thin film polyvinylchloride films, and (4) special finishes. The paints and coatings were applied either by brush or trowel. The

thin film wallcoverings were bonded to the substrate using recommended adhesives. The laminated test specimens were bonded using a combination of adhesives and hot press techniques used in manufacturing.

### 3.2 APPARATUS/INSTRUMENTATION

The test apparatus used for this project was constructed in accordance with the requirements outlined in Resolution A.564(14). The tests were conducted at the National Bureau of Standards, Gaithersburg, Maryland by Coast Guard personnel. The principle components of the apparatus were a gas fired radiant panel, sample holder, pilot flame assembly, and a fume stack with hood. The test apparatus was installed in a 6.7 m x 6.7 m x 3.8 m laboratory. The apparatus was located in the center of the laboratory under a skirted hood. The radiant panel was fired with a mixture of natural gas and air. An acetylene/air flame was used as the pilot. Figures 1A and 1B show overall and close-up views of the apparatus.

Instrumentation used to obtain and record data included:

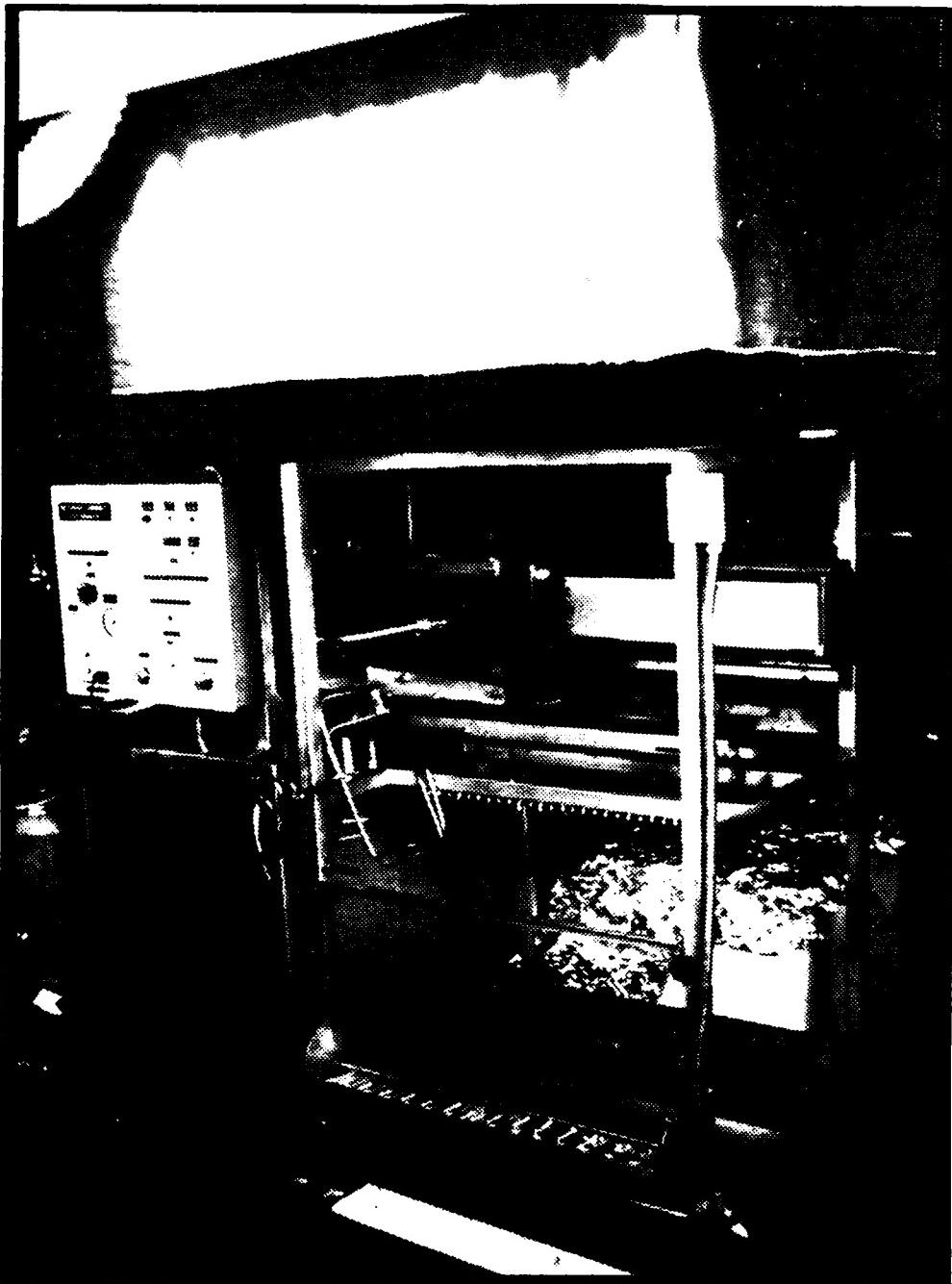
Heat Flux Sensors: Medtherm Model 64-3-20

Radiation Pyrometer: Honeywell, Model 939A4 Miniature Radiamatic Pyrometer.

Data Acquisition: Hewlett Packard Model 7100B-04-1 Strip Chart Recorder.

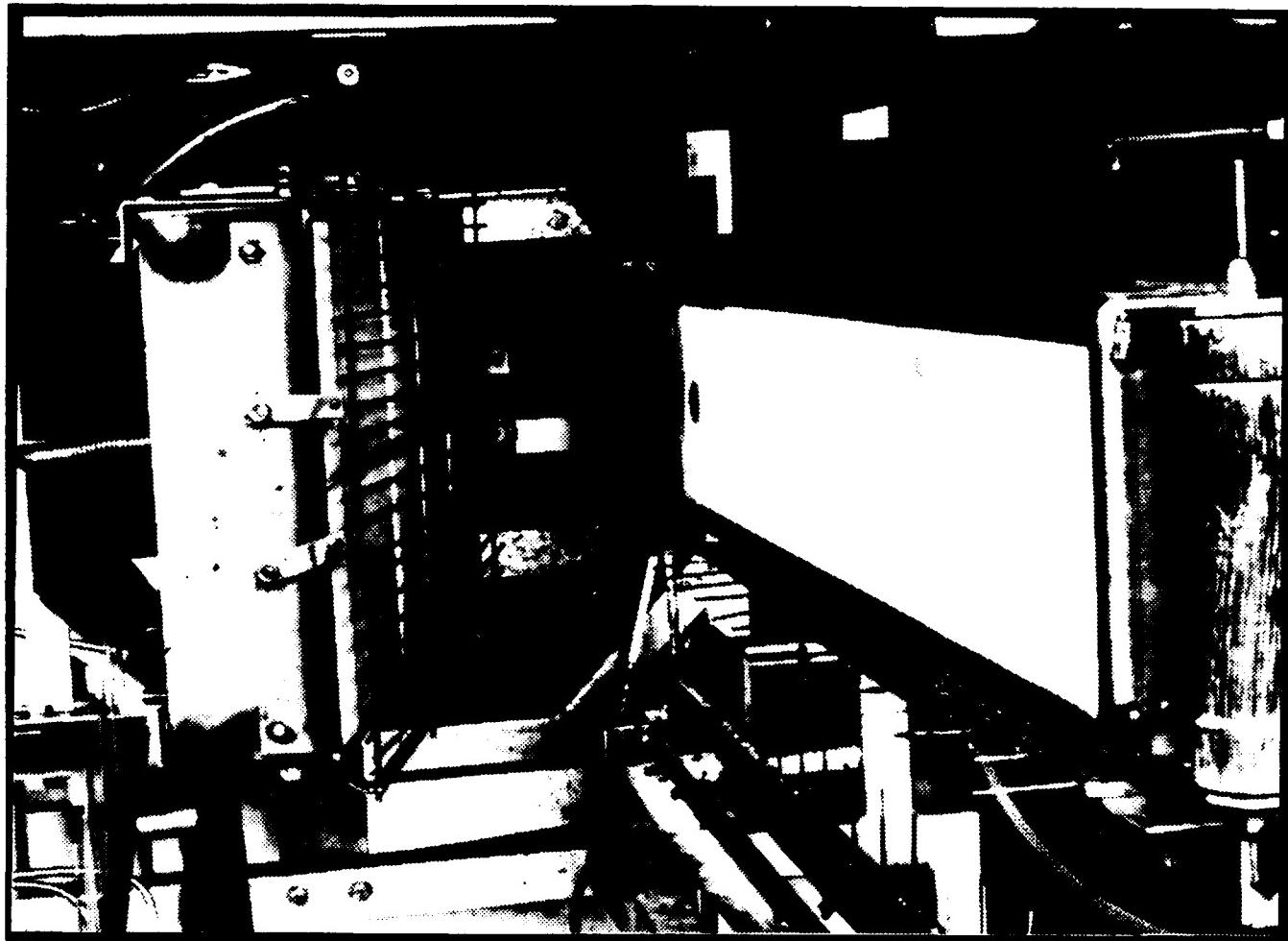
Hewlett Packard Model 3497A Data Acquisition/Control Unit interfaced with an IBM Personal Computer.

IMO Flame Spread Apparatus: Loften Corporation.



a. Overall Test Apparatus

**FIGURE 1. IMO Spread of Flame Test Apparatus**



b. Radiant Panel and Vertical Pilot

**FIGURE 1. IMO Spread of Flame Test Apparatus**

### 3.3 CALIBRATION PROCEDURES

#### 3.3.1 Flux Distribution Calibration

In order to calibrate the test apparatus with respect to flux, a dummy specimen was mounted in the apparatus sample holder in accordance with the A.564(14) test procedures. The dummy specimen was constructed with two (12.7 x 155 x 420 mm and 12.7 x 155 x 800 mm) Marinite I sections with the 420 mm section positioned in front of the 800 mm section relative to the face of the radiant panel. Circular holes were cut along the dummy specimen center line at 50, 200, 350, 500 and 650 mm to accommodate the Medtherm flux sensor. The incident flux was adjusted to 50.5 kW/m<sup>2</sup> at 50 mm and to 23.9 kW/m<sup>2</sup> at 350 mm. The variance for these values was approximately +/- 0.1 kW/m<sup>2</sup>. The flux was adjusted by a combination of mechanical position changes in the relative positions of the radiant panel and sample holder, and by changes in the fuel/air mixture ratio and volumetric flows. When the two point calibration had been achieved, the heat flux sensor was placed in the surface plane at each flux station and the results recorded. The holder was then re-positioned 50 mm from the original hot end position and the surface flux recorded at 100, 250, 400, 550, and 700 mm.

Finally the holder was repositioned 100 mm from the hot end and data recorded at 150, 300, 450, 600 and 700 mm. When the flux distribution over the dummy specimen was within the prescribed limits of the test method, the radiation received by an optical pyrometer centered on the middle section of the radiant panel was recorded. Typical results for the flux distribution are shown graphically in Figure 2 and tabulated in Table 1.

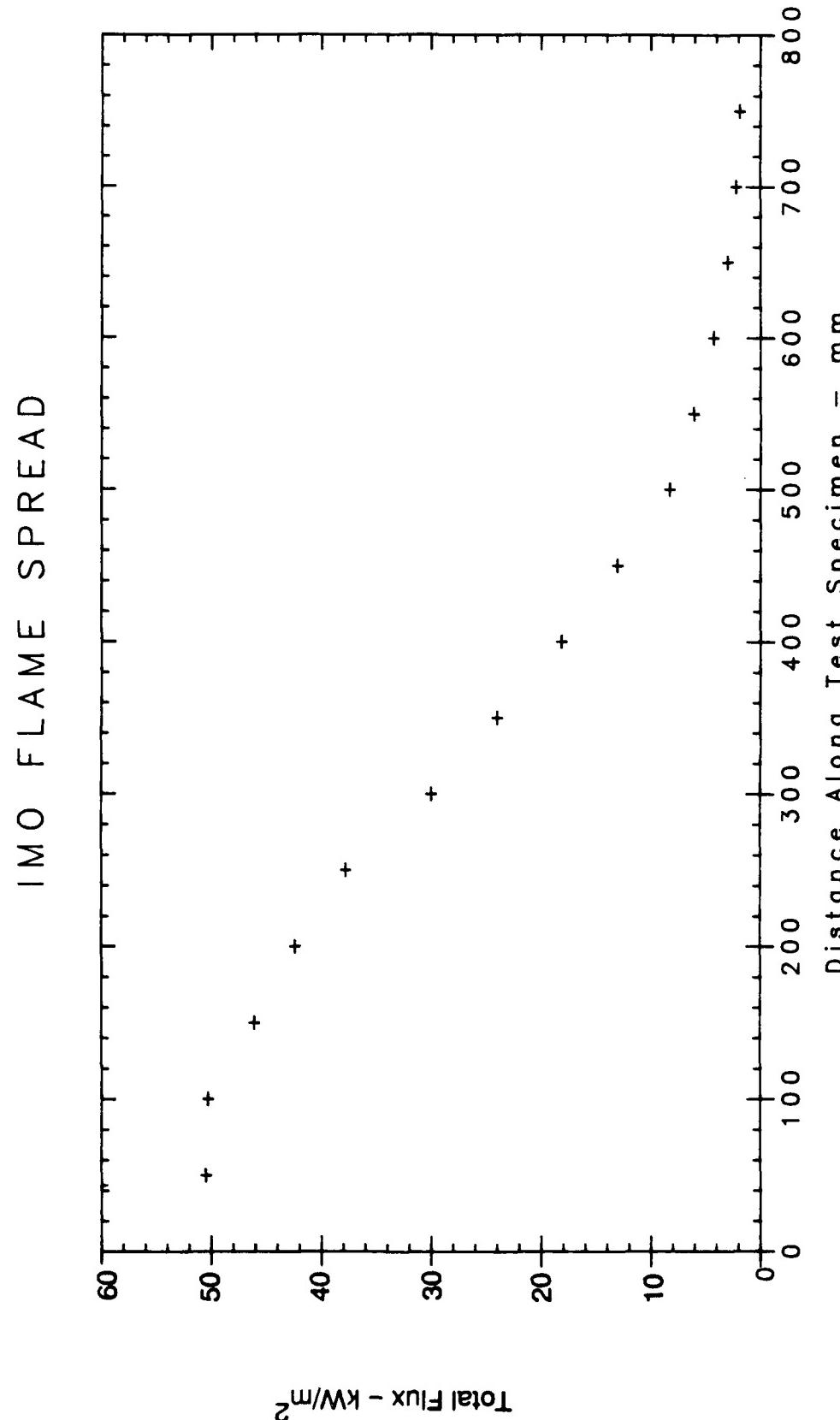


FIGURE 2. FLUX VS DISTANCE ALONG TEST SPECIMEN

TABLE 1  
FLUX CALIBRATIONS USING DUMMY SPECIMEN

Distance along test specimen (mm)	Total Flux (kW/m <sup>2</sup> )
50	50.5
100	50.3
150	46.1
200	42.4
250	37.8
300	30.0
350	24.0
400	18.2
450	13.1
500	8.3
550	6.1
500	4.3
650	3.0
700	2.2
750	1.9

### 3.3.2 Stack Thermocouple System

The stack thermocouple system consisted of a set of thermocouples located in the upper stack and a thermocouple attached to the stack wall. The system was calibrated using a 240 mm line burner placed along the center line of a dummy sample and positioned at the hot end of the test apparatus. The dummy sample was a 155 x 800 x 12.7 mm sheet of Marinite I. The thermocouples were 0.25 mm in diameter. The compensation adjustment described in the test protocol was 51 percent. Ninety eight percent methane was used as the fuel for the line burner. The methane flow was measured using a positive displacement gas flow meter. The line burner was in place before the start of the fuel flows. The calibration procedure consisted of opening up

the fuel control value to an initial setting and measuring the millivolt output from the differential stack thermocouple system. The fuel flow was increased and the process repeated. The energy output was varied over a range (up to 11 kW) which bracketed the test data. The maximum heat release rate for the materials tested was 7.1 kW.

### 3.3.2.1 Heat Release Rate

The heat released from a test specimen was evaluated by comparing the change in the stack thermocouple system output during a test with the change resulting from a line burner operated at known fuel flow rates. Rate of heat release data was obtained over a variety of pilot operating configurations. The data reported in Section 4 was based on calibration with the radiant panel in operation at a measured flux level of  $50.5 \text{ kW/m}^2$  at 50 mm and with the vertical pilot configuration.

Data for the rate of heat release versus the differential stack thermocouple output without a pilot in operation is presented graphically in Figure 3A and in tabular form in Table 2A. Similar data for the vertical and impinging pilot configurations are outlined in Figures 3B and 3C and Tables 2B and 2C. In transforming the raw voltage data to engineering units, only the vertical pilot data was used.

This function was obtained by performing a least squares analysis on the data to fit a linear polynomial function.

$$Y = A(0) + A(1)X + (A2)X^2 + \dots$$

where Y is the heat release rate,  
X is the raw voltage data, and  
 $A(i)$  = are term coefficients.

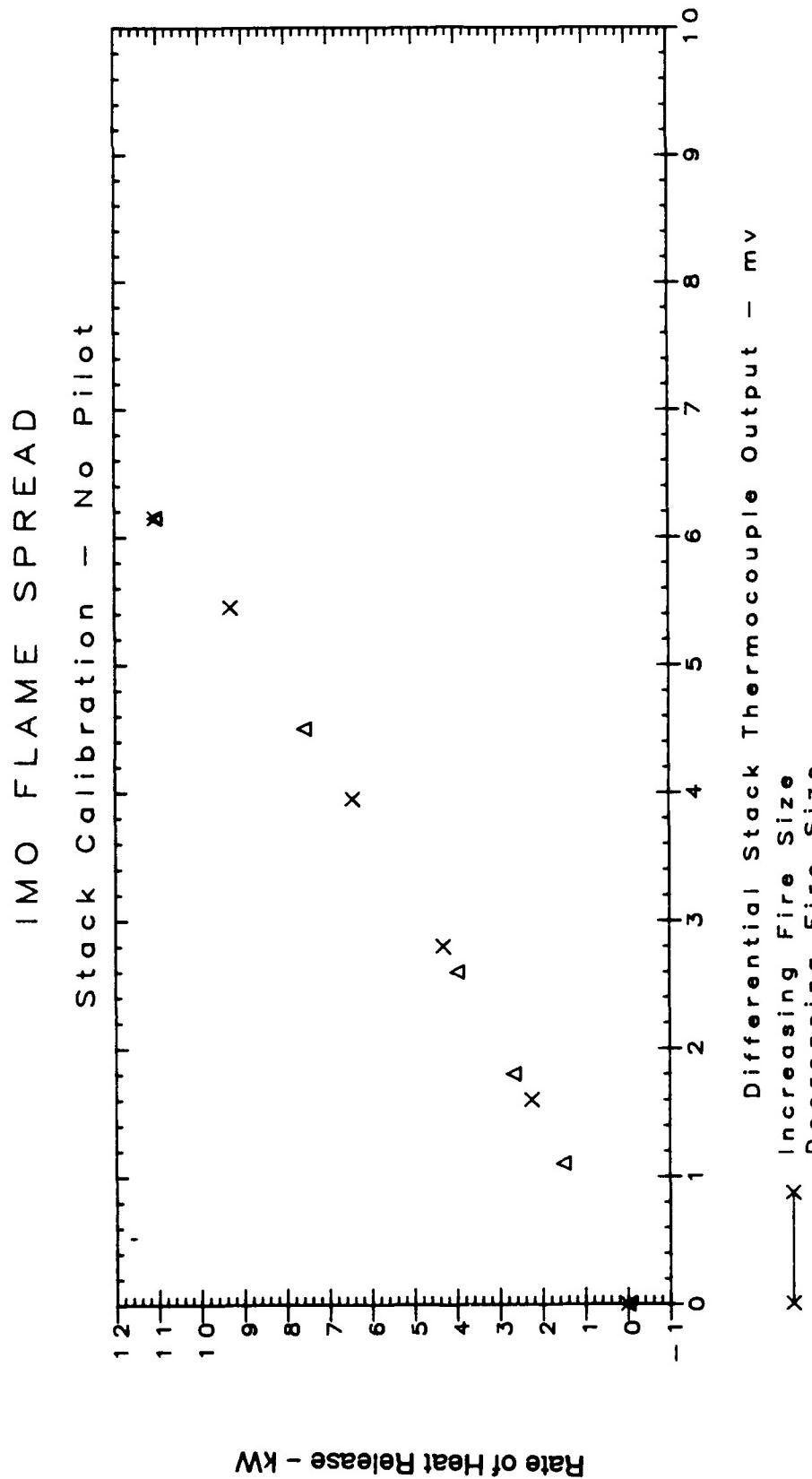


FIGURE 3A. RATE OF HEAT RELEASE VS STACK THERMOCOUPLE  
OUTPUT-NO PILOT

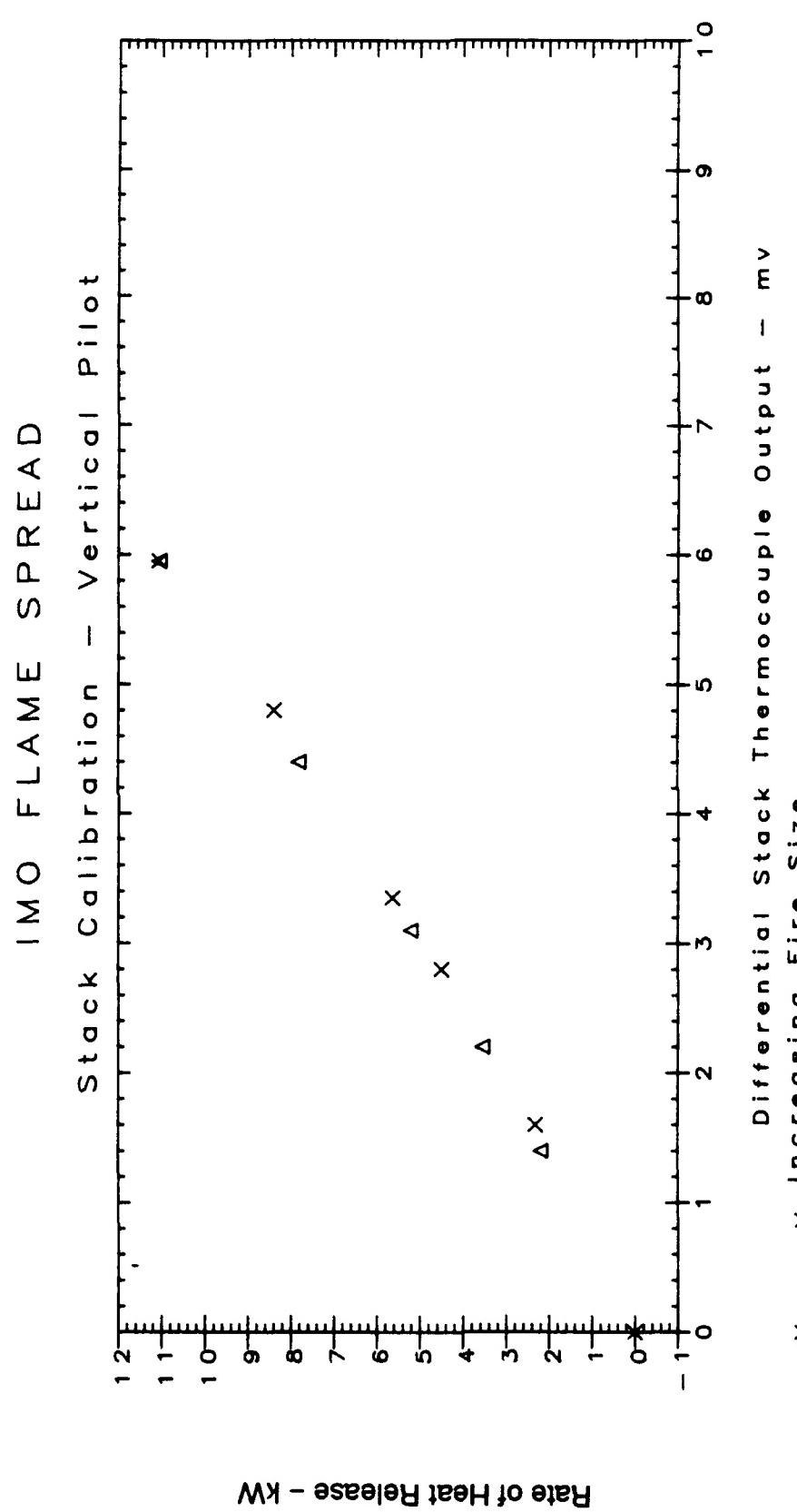


FIGURE 3B. RATE OF HEAT RELEASE VS STACK THERMOCOUPLE OUTPUT-VERTICAL PILOT

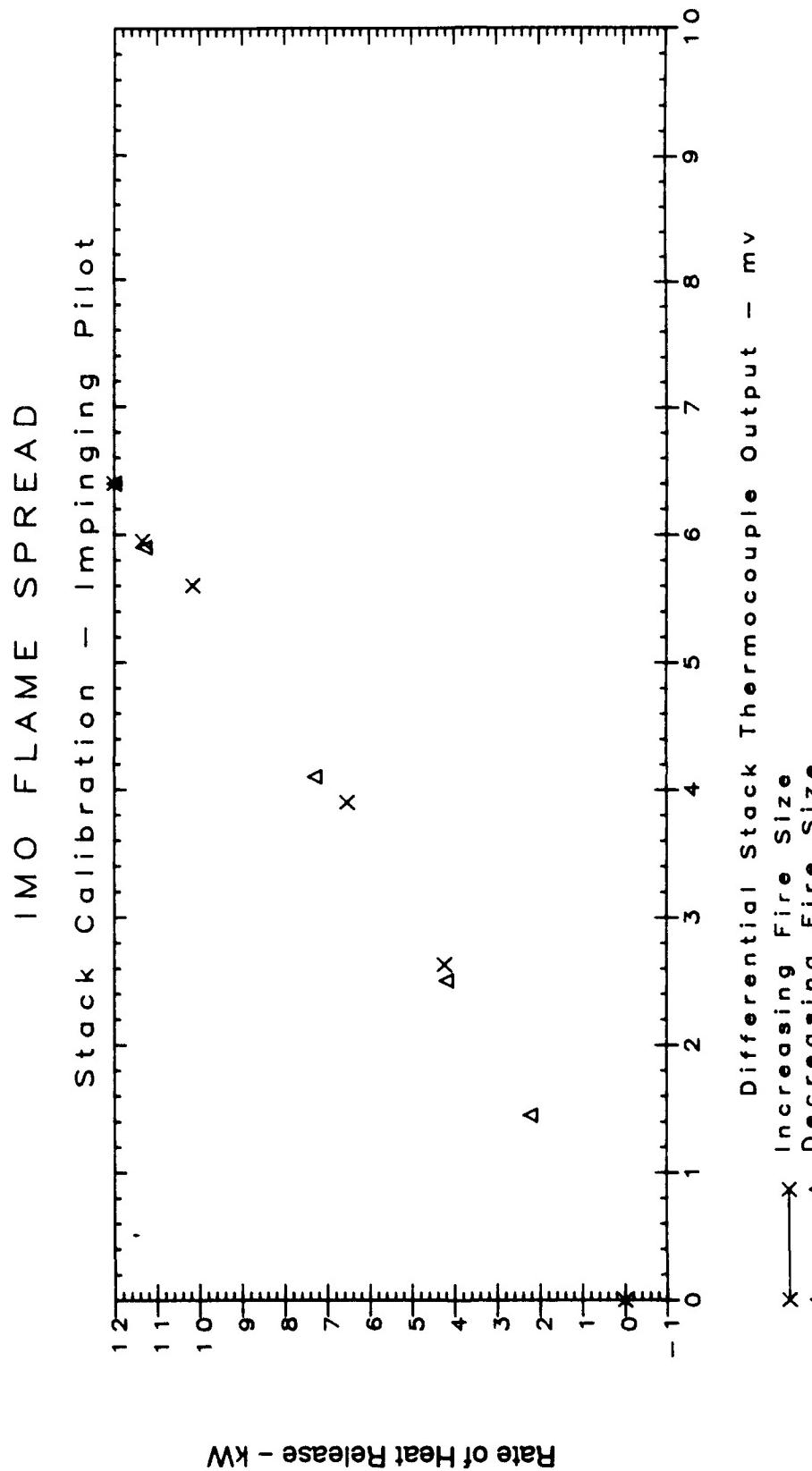


FIGURE 3C. RATE OF HEAT RELEASE VS STACK THERMOCOUPLE  
OUTPUT-IMPINGING PILOT

TABLE 2  
CALIBRATION FOR RATE OF HEAT RELEASE FOR  
DIFFERENT PILOT FLAME CONFIGURATIONS

a		b		c	
No-pilot		Vertical		Impinging	
mv	kW	mv	kW	mv	kW
1.1	1.5	0.0	0.0	0.0	0.0
1.6	2.2	1.4	2.2	1.4	2.2
1.8	2.7	1.6	2.3	2.5	4.2
2.6	3.9	2.2	3.6	2.6	4.2
2.8	4.3	2.8	4.5	3.9	6.5
3.9	6.4	3.1	5.2	4.1	7.3
4.5	7.6	3.3	5.6	5.6	10.1
5.4	9.3	4.4	7.8	5.9	11.3
6.1	11.0	4.8	8.4	5.9	11.3
		5.9	11.0	6.4	12.6

### 3.3.2.2 Stack Thermocouple Response Rate

The stack thermocouple response rate was determined using a square wave flame heating source according to the prescribed protocol. This process involves measuring the time delay in the stack thermocouple system output from an ambient condition with the apparatus in normal operation to a steady state condition resulting from a suddenly applied heat source. According to the test procedures the compensation factor should be about 50 percent. The compensation factor was 51 percent for these tests. The methane gas flow used to simulate a burning test specimen was adjusted to correspond to approximately the peak heat release value for the materials tested. The line burner used for this adjustment was the same as that used for the stack calibration outlined in Section 3.3.2.1. To verify that the response rate was not affected by the pilot flame square wave curves were developed for each pilot configuration. These curves are presented in Figures 4A, B, C. In all cases the data is similar, showing a rise to 90 percent of the signal in approximately 30 seconds and decay to the operating baseline in 120 seconds.

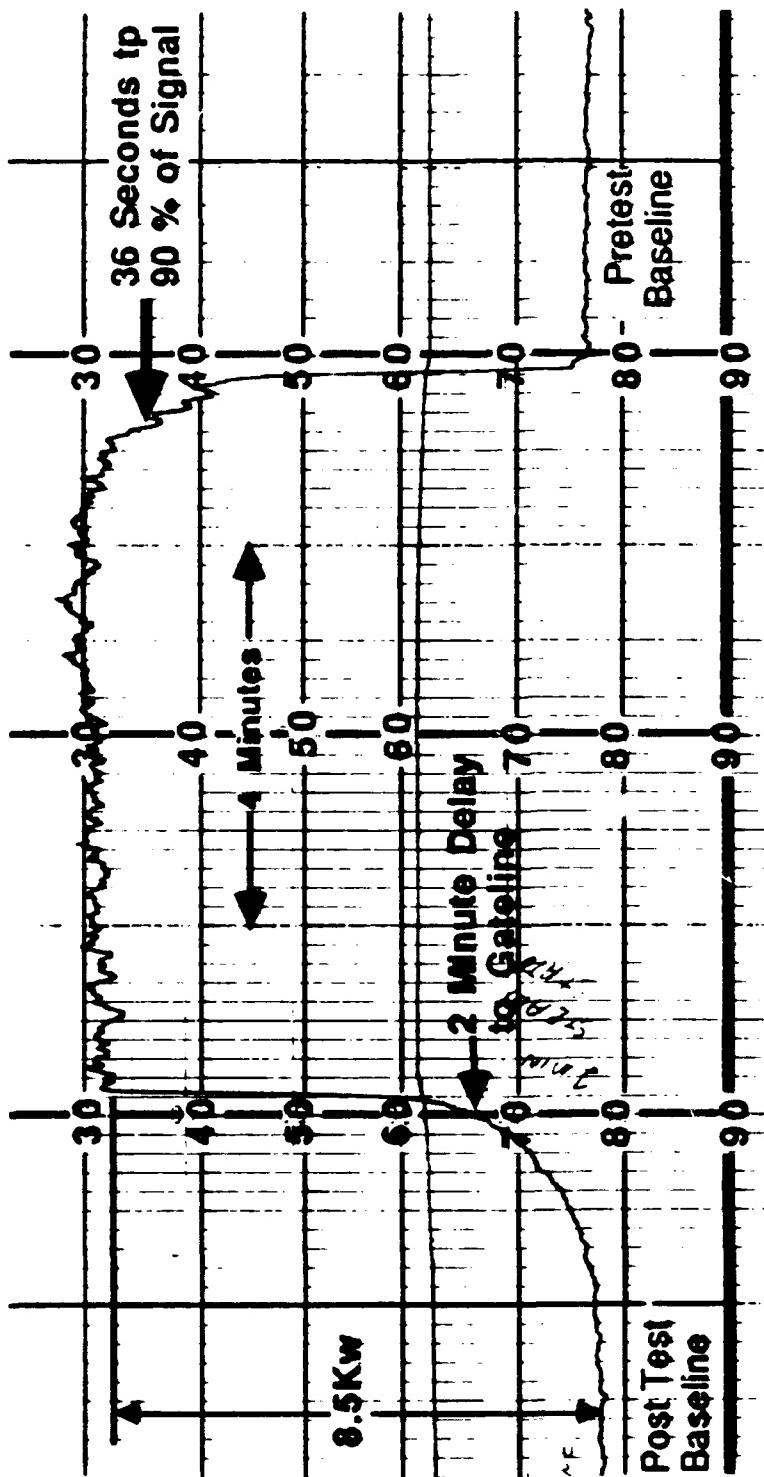


FIGURE 4A. Response Rate for Stack Thermocouple System - NO-PILOT

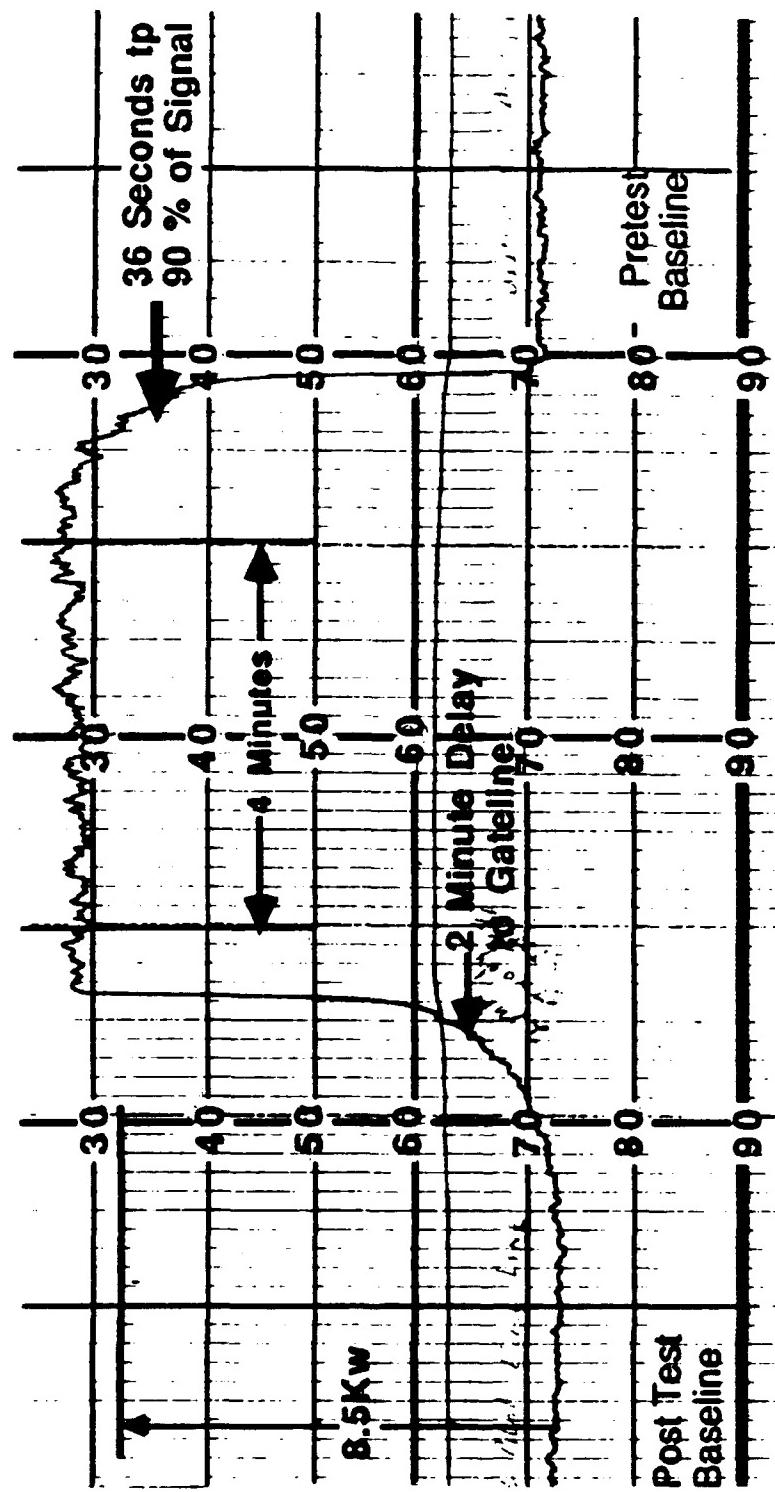


FIGURE 4B. Response Rate for Stack Thermocouple System - VERTICAL PILOT

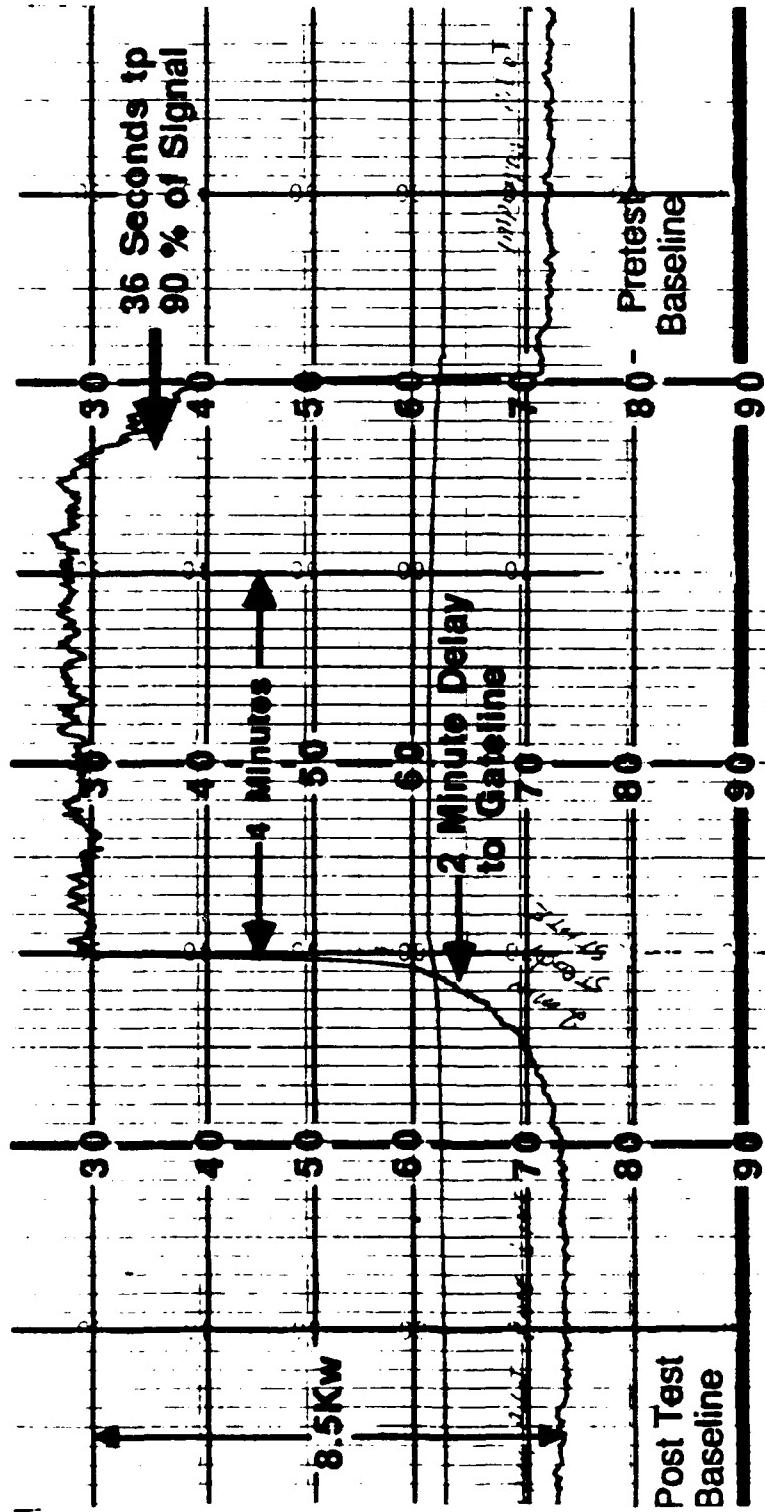


FIGURE 4C. Response Rate for Stack Thermocouple System - IMPINGING PILOT

### 3.4 DATA ACQUISITION

#### 3.4.1 Ignition and Flame Propagation

The Critical Flux at Extinction, Heat for Sustained Burning, and Heat for Ignition all require test data regarding the ignition and propagation of flaming along the test sample. The test protocol assumes that an ignition occurs in a reasonably uniform manner and that the flame progresses in an orderly way along the test sample. For many of the materials tested, these processes were neither uniform nor orderly. Major problems were encountered in defining the ignition and flame spread rate in tests using laminates applied to Marinite. These problems arose because of the explosive delamination of material from bubbles formed on the sample surface. This resulted in the formation of discontinuous areas of flaming, particularly during the earlier flame development. Similar but less pronounced discontinuous flaming was observed for some of the vinyl chloride wallcoverings. For several of the test samples, the flames were attached near the bottom or top edge of the sample holder. Because of these difficulties, the flame front position was interpreted as being the distance to which "sustained" flaming had progressed rather than the center line position.

The Time to Ignition was taken as the time to the development of a sustained flame front at the 150 mm distance. In a number of tests there was some difficulty in defining ignition. These difficulties were caused by a number of transient physical and combustion phenomena including the delamination of the bulkhead finish from the substrate, and for one material, the development of precursor cool flames which flashed along the length of the sample surface. Therefore, the ignition time was somewhat subjective depending on the experience of the test operator. The criteria used was that there be "sustained" flame development with the definition of sustained being left to the best judgement of the test operator.

The Heat for Sustained Burning was calculated by taking the average of the time required for the flame front to reach marked 50 mm intervals from 150 to 450 mm or to the distance of flame extinction.

### 3.4.2 Heat Release Rate

The rate of heat release was determined using the stack thermocouple system. The raw data voltage signal from the system was recorded using both a strip chart recorder and an IBM PC computer. The strip chart recorder provided a continuous trace of the signal. The IBM PC computer was set to scan at one (1) second intervals. The raw voltage data was converted to engineering units using the stack calibration function for operation with a vertical pilot.

The test operating procedures included providing a background scanning interval for the computer data logging system. During the Part 1 test series (using GRC board) a minimum of 40 seconds of data was recorded prior to the insertion of the test sample into the test apparatus. This pretest background interval was extended to 300 seconds for the remainder of the tests. One reason for the extension of time was that the signal stability tended to drift slightly from the established base line signal level 10 to 40 seconds before the start of test. The drifting was correlated with the necessary movements of test personnel in the vicinity of the test apparatus which apparently affected the draft in the fume hood/stack systems.

The pretest signal data was used both to verify the thermal stability of the test apparatus and to provide an individual test base line referenced to the specific operating conditions for each test. Verification of the thermal stability of the test apparatus was made by a visual inspection of the time vs raw voltage data file. Values for individual test base lines were developed by averaging pretest stack thermocouple signal data

over an appropriate interval. In practice a 10-second interval approximately 100 seconds prior to the test was used for this purpose.

The Maximum Rate of Heat Release was evaluated by taking the peak value during the test run, subtracting from this value the individual pretest base line and then adding a correction for the cooling effect of the cold sample. The cooling effect was estimated by inserting a dummy sample of the substrate used for sample preparation and recording the thermocouple output as a function of time. For most of the tests reported herein, the correction was approximately 0.5 kW. A typical plot showing the effect of the heating process on stack thermocouple output is shown in Figure 5A. It is noted that this correction is appropriate for thin films applied to incombustible substrates but may require modification for thick combustible materials and complex constructions. The effect of the cold sample correction is to introduce a shifting base line with respect to time. In calculating the maximum rate of heat release, the correction factor used corresponded to the same time as the maximum in the rate of heat release data and its value was calculated by subtracting the base line of the dummy sample from the observed stack thermocouple output signal. For most of the tests reported herein, this correction was approximately 0.1 MJ.

### 3.4.3 Total Heat Release

The Total Heat Release was calculated by integrating the rate of heat release data (in engineering units) from the time of sample insertion to approximately three minutes after the last observed flaming (Figure 5B). The integration was corrected for the base operating level of the test apparatus by subtracting the area under the base line as previously determined from the pretest average. Finally a correction was made for the sample cooling effect. This correction was made by using the average of three Marinite I dummy specimen tests.

IMO FLAME SPREAD TEST

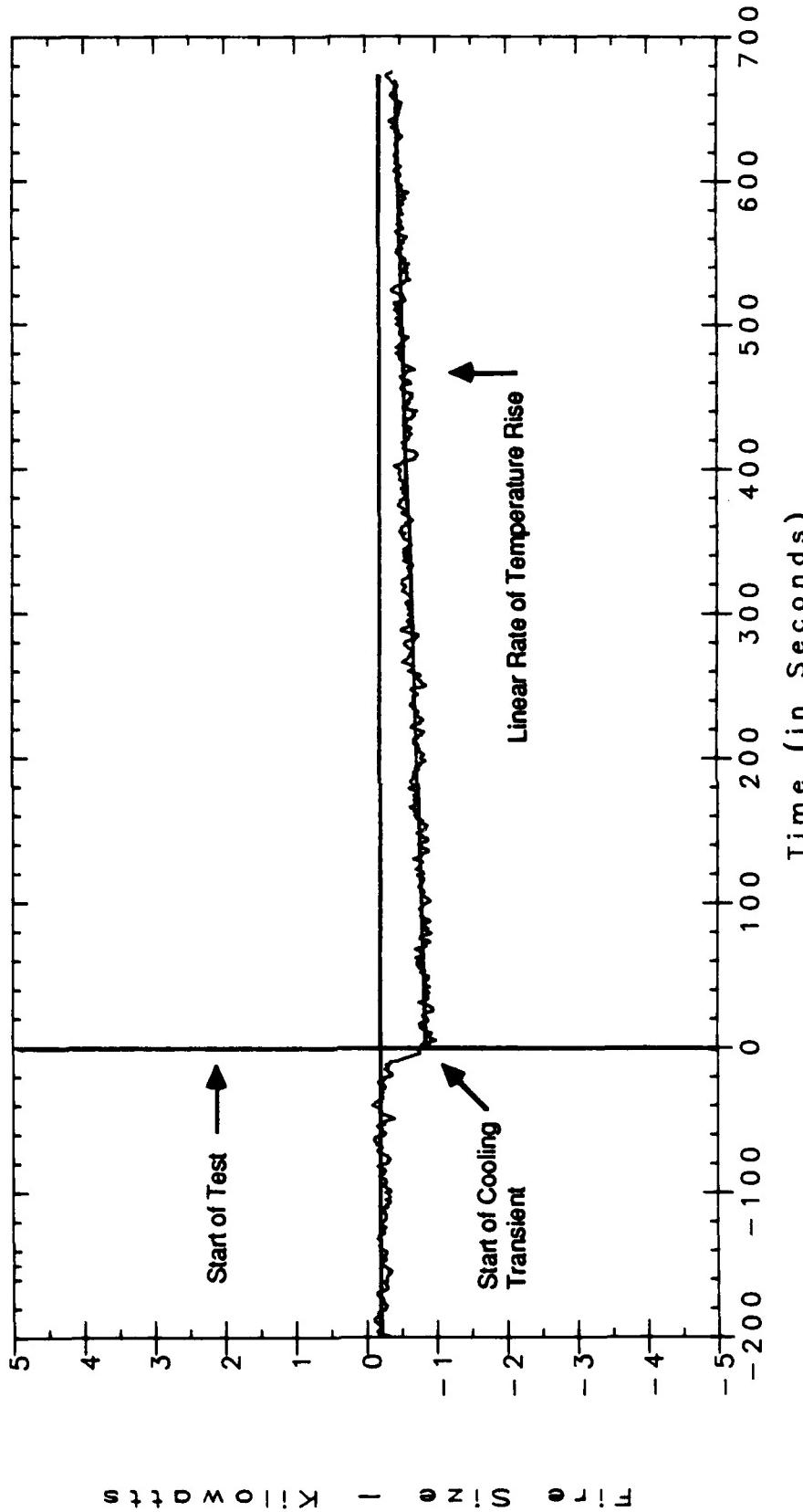


FIGURE 5A. HEAT RELEASE VS TIME-COLD SAMPLE EFFECT

IMO FLAME SPREAD TEST

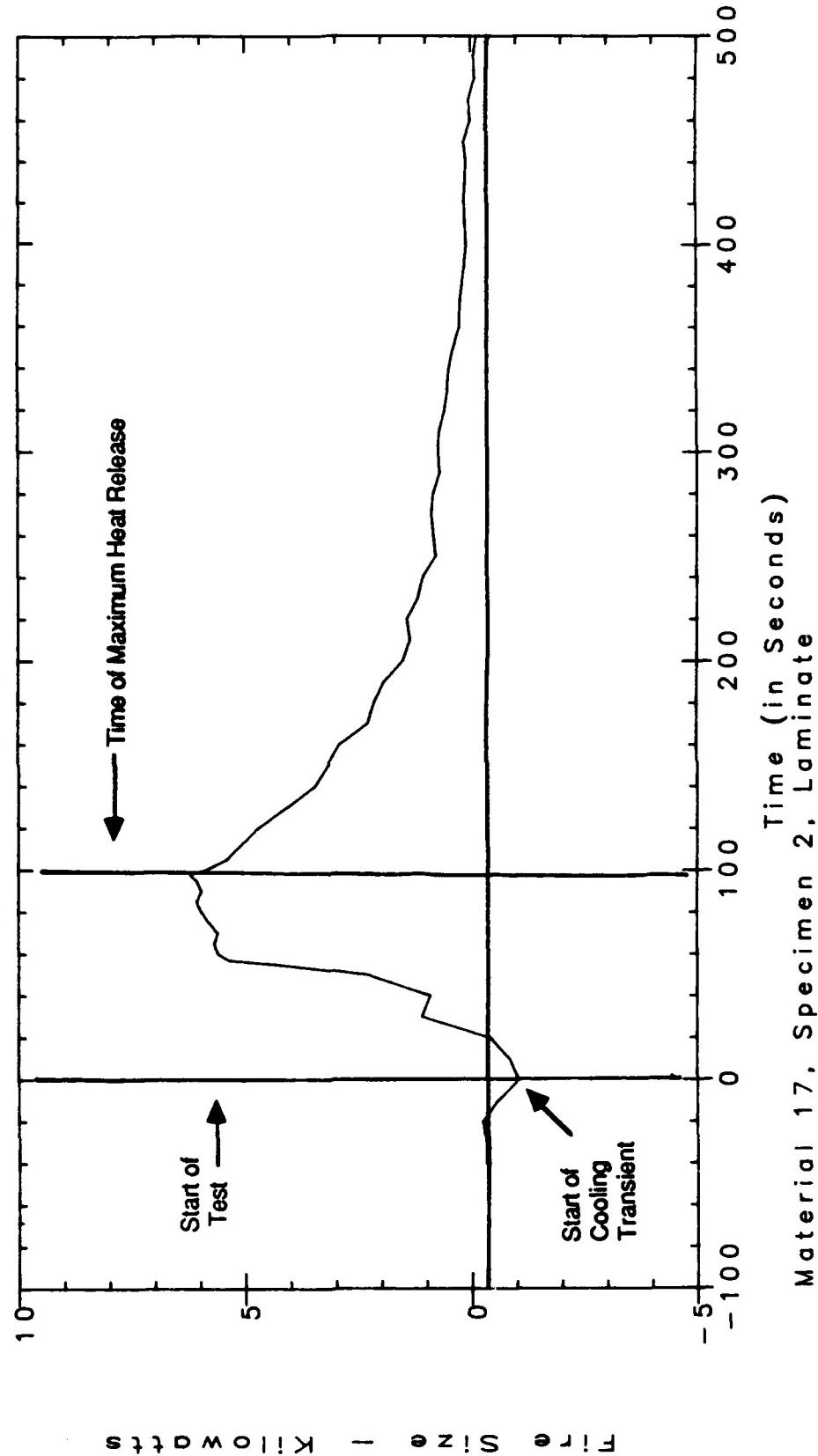


FIGURE 5B. HEAT RELEASE VS TIME-TYPICAL TEST SPECIMEN

Material 17, Specimen 2, Laminate

#### 3.4.4 Optical Pyrometer

An optical pyrometer was used to record the variation in radiant flux from the radiant panel. This record was documented using a strip chart recorder channel. Since the data is not used in the determination of any of the test parameters, the strip chart recorder data was not processed. In general, the data provides nonquantitative data on the reduction of incident flux on the test sample caused by the introduction of cold test samples and assists in verifying the consistency of radiant panel operation prior to the insertion of the test sample.

#### 3.5 ASTM E-84 TEST PROCEDURES

The tests were conducted in accordance with the provisions of ASTM E-84, "Standard Method of Test for Surface Burning Characteristics of Building Materials." The purpose of the test is to evaluate performance of the test specimen in relation to that of glass reinforced cement board and red oak flooring under similar fire exposure. The results are expressed in terms of flame spread index, fuel contribution, and smoke developed during a 10-minute exposure, and are recorded as a ratio with glass reinforced cement board as zero and red oak flooring as 100. To allow for possible variations in results due to limitations of the test method, the numerical results were adjusted to the nearest figure divisible by five (5). The tests were conducted in accordance with normal commercial practices at Southwest Research Institute, San Antonio, Texas.

#### **4.0 RESULTS**

For each material a minimum of two IMO and one ASTM E-84 tests were performed. In accordance with the IMO test procedure two tests were made using a vertical pilot. If sustained ignition did not occur then additional tests were conducted using an impinging pilot. The test results are summarized in the next two sections corresponding to the substrate onto which the materials were applied.

#### 4.1 MATERIALS APPLIED TO MARINITE I

A total of nineteen materials were evaluated applied to Marinite I, a marine board substrate. Test results for these materials are summarized in Table 3. The materials are described in detail in Appendix A. Included in this description are the types of bonding agents used in their application. A typical view of test specimens after testing is shown in Figure 6.

The materials are divided into four classifications: laminates, coatings, PVC wallcoverings, and a special finish. Materials accepted for marine use by the U.S. Coast Guard are numbered from 1 to 10. Materials not currently accepted are numbered from 15 to 23. In order to determine the effect of sample orientation on the IMO test parameters, tests for the laminated specimens were conducted in both the cross directional and machine direction orientations. These are designated as CD and MD, respectively.

The data in Table 3 represent average values for several samples of each test material. Both vertical and impinging ignition pilot orientations were included in these averages. The test results obtained by Underwriters Laboratories (U.L.) are indicated in parentheses adjacent to the U.S. Coast Guard values in Table 3. Test results from U.L. are provided in more detail in Appendix D. U.L. results were obtained using only one sample in most cases.

The data is summarized for five IMO test parameters. Two of these, the Critical Flux at Extinguishment and the Heat for Sustained Burning are currently recommended for acceptance. Since the protocol specifies that the time of occurrence for the maximum rate of heat release be included in the data, this parameter together with the maximum rate is included in the Maximum Heat Release column. Data for the Total Heat Release for Material 19 were considered unreliable and not reported. A detailed description of the events occurring during the tests is contained in Appendix B. The time values used for these



FIGURE 6. TEST SPECIMENS AFTER FIRE EXPOSURE  
ORDER FROM TOP: M9, M8, M10, M5, M4,  
M3, M2, M1

TABLE 3  
SUMMARY FOR MATERIALS APPLIED TO MARINITE I MARINE BOARD

MATERIAL	ASTM E-84 FLAME SPREAD INDEX	HEAT OF IGNITION	HEAT OF SUSTAINED BURNING	CRITICAL FLUX AT EXTINGUISHMENT (MJ/m <sup>2</sup> )	MAXIMUM HEAT RELEASE TIME (SEC)	MAXIMUM HEAT RELEASE RATE (kW)	TOTAL HEAT RELEASE (MJ)
		(MJ/m <sup>2</sup> )	(MJ/m <sup>2</sup> )	(kW/m <sup>2</sup> )	(sec)	(kW)	(MJ)
<b>A. LAMINATES</b>							
M3CD	5	3.51	4.07	41	62	2.90	0.318
M3MD	5	2.86	4.26	40(42) <sup>+</sup>	59	3.44(2.2)	0.352(0.18)
M1CD*	10	8.05	8.20	30	122	2.54	0.412
M1MD**	10	7.76	8.22	39(37)	196	3.00(2.6)	0.450(0.49)
M2CD	20	6.26	7.02	30	144	3.56	0.412
M2MD	20	5.75	6.82	38(30)	127	3.63(2.8)	0.391(0.43)
M15	85	1.57	2.74	27(30)	58	5.67(6.2)	0.613(0.57)
M17	150	2.63	3.30	25(27)	82	6.82(7.6)	0.970(0.89)
M16	180	1.60	2.07	28(30)	41	6.83(7.4)	0.784(0.80)
<b>B. COATINGS/PAINTS</b>							
M4	5	.78	0.97	27	17	5.52	0.205
M6	5	3.53	4.28	27	96	4.33	0.298
M5	15	.91	1.17	13	58	6.08	0.623
M23	20	1.77	2.80	36(37)	33	3.70(3.2)	0.544(0.52)
M22	55	0.85	0.91	27(30)	28	4.97(3.1)	0.120(0.11)
M21	220	0.80	0.99	11	32	6.13	0.278
<b>C. PVC WALLCOVERING</b>							
M8	5	0.59	1.06	25	38	4.48	0.222
M9	5	0.55	1.37	29(26)	34	3.55(3.2)	0.161(0.20)
M10	5	0.77	0.88	35	26	4.30	0.106
M20	20	0.46	0.44	9(10)	63	7.12(7.7)	1.22(0.91)
M19	75	0.83	1.00	26	44	2.57	-
M18	130	0.57	0.80	13(18)	43	6.74(7.3)	0.858(0.82)
<b>D. SPECIAL FINISHES</b>							
M7	5	No ign.++	No ign.	50	54	1.10	0.00

\* values in parenthesis are replicate samples evaluated at U.L. (see Appendix D)

\* cross direction of laminate applied to sample length.

\*\*machine direction of laminate applied to sample length.

++no ignition

descriptions were obtained by a post test analysis of tapes of voice recordings from the test operator. Data for the ASTM E-84 tests are summarized in Appendix C.

#### 4.2 MATERIALS APPLIED TO GLASS REINFORCED CEMENT BOARD

A total of ten materials were evaluated applied to a glass reinforced cement board. This board had the same physical properties as that used for the ASTM E-84 tests. Results for these tests are summarized in Table 4. All ten materials tested were listed as acceptable for use as interior finishes by the U.S. Coast Guard. Details of individual tests are summarized in Appendix B and Appendix C for the IMO A.564(14) and the ASTM E-84 tests respectively. The ten materials evaluated were classified into the same four classifications: laminates, coatings, PVC wallcoverings, and a special finish. The effect of sample orientation for the laminated test specimens was not considered.

Test results for these materials are summarized in Table 4. Again the data in Table 4 represent average values of several individual tests. Data from both vertical and impinging pilot configurations are included in these averages. Although some flaming was observed for most of the test specimens, the flaming was not considered to have developed into a steady sustained flame front.

The laminates formed an exception to this generalization. For the laminated test specimens the explosive delamination still occurred but the material adjacent to the "bubble" or gas pocket remained relatively well bonded to the substrate for a much longer time period. Eventually there was some peeling away and combustible gases trapped along the underside of the laminate ignited. The process for GRC board, however, was much less pronounced than for Marinite. The Critical Flux at Extinguishment for the three laminates tested ranged from 42 to  $49 \text{ kW/m}^2$ . The rank ordering of the laminates in terms of the relative relationship between ASTM E-84 and IMO test results was consistent with their anticipated fire flammability.

TABLE 4

## DATA SUMMARY FOR MATERIALS APPLIED TO GLASS REINFORCED CEMENT BOARD

MATERIAL	ASTM E-84 FLAME SPREAD INDEX	HEAT OF IGNITION (MJ/m <sup>2</sup> )	HEAT OF SUSTAINED BURNING (MJ/m <sup>2</sup> )	CRITICAL FLUX AT EXTINGUISHMENT (kW/m <sup>2</sup> )	MAXIMUM HEAT RELEASE TIME (SEC)	RATE (kW)	TOTAL HEAT RELEASE (MJ)
<b>A. LAMINATES</b>							
M3	5	No ign.+	No ign.	49	--	0.55	0.279
M1	10	3.6	3.3	47	--	0.82	0.365
M2	20	14.7	14.2	42	--	1.15	0.419
<b>B. COATINGS/PAINTS</b>							
M4	5	No ign.	No ign.	>50	--	nil++	0.045
M6	5	No ign.	No ign.	>50	--	nil	0.008
M5	15	No ign.	No ign.	>50	--	0.16	0.085
<b>C. PVC WALLCOVERING</b>							
M8	5	No ign.	No ign.	>50	--	0.07	0.037
M9	5	No ign.	No ign.	>50	--	0.10	0.121
M10	5	No ign.	No ign.	>50	--	nil	0.140
<b>D. SPECIAL FINISHES</b>							
M7	5	No ign.	No ign.	>50	--	nil	0.083

+ no ignition

++not in limit of measurement

Three of the four classes of materials (coatings, PVC wallcoverings, and a special finish) did not form a stabilized flame front and were therefore not ignited. For these materials the Heat for Ignition and the Heat for Sustained Burning were not defined. Also the Critical Flux at Extinguishment was considered to be greater than the maximum incident thermal flux at the hot end of the test specimen (i.e.,  $> 50 \text{ kW/m}^2$ ). For these materials the rate of heat release was low and the Total Heat Release and Maximum Rate of Heat Release parameters were also quite small. The heat release data reported in Tables 3 and 4 were corrected for the cold sample effect.

## 5.0 DISCUSSION

### 5.1 RELATIONSHIPS BETWEEN ASTM E-84 AND IMO SPREAD OF FLAME TEST PROCEDURES

The major objective of this project was to provide information about the flammability of interior finish materials which could be used to assist in the development of pass/fail criteria for the IMO spread of flame test method. The general approach consisted of a comparative study in which selected materials accepted by the U.S. Coast Guard were evaluated using both the national test (ASTM E-84) and the proposed IMO test method. Results from the two test methods were then to be compared and a determination made regarding whether proposed IMO pass/fail criteria would provide at least the same level of fire safety as the criteria used by the Coast Guard regulations.

#### 5.1.1 Limiting Values for IMO Test Parameters

One way to make such a comparison is to graphically plot each of the IMO test parameters against the ASTM E-84 Flame Spread Index (FSI). This comparison is made in Figures 9 through 13. Current Coast Guard regulations accept materials having FSI values equal to or less than 20.

The Critical Flux at Extinction (CFE) is plotted against FSI in Figure 7. The data is divided into three major categories:

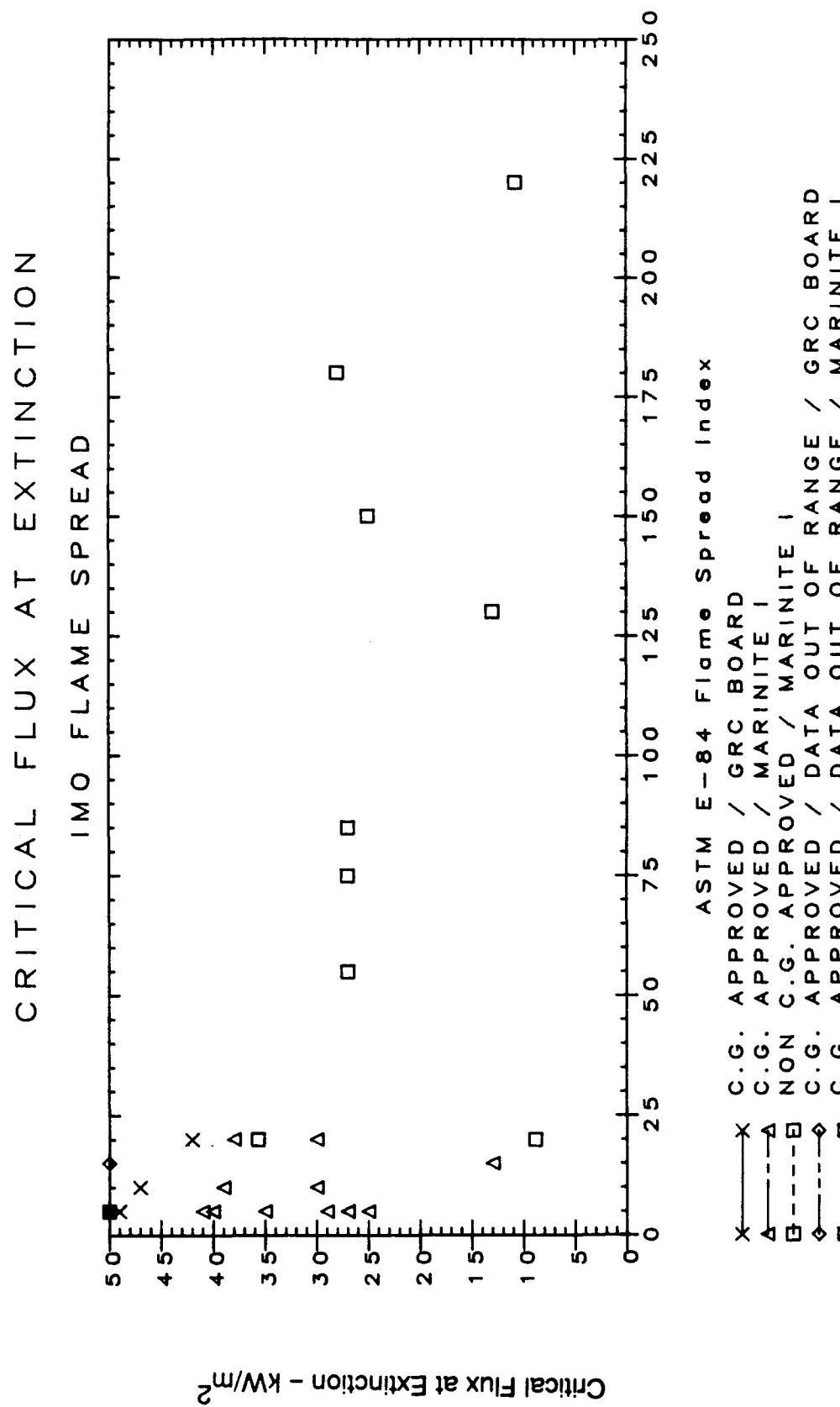


FIGURE 7. CRITICAL FLUX AT EXTINCTION VS FLAME SPREAD INDEX

- (1) Coast Guard approved material mounted on GRC board,
- (2) Coast Guard approved material mounted on Marinite I, and
- (3) non-approved material mounted on Marinite I.

The non-approved material was selected to provide a wide range of values with respect to FSI. Including all materials the range for FSI varied from 5 to 220. These values may be compared to the Class A (0-25), Class B (25-75), and Class C (75-200) classifications used in many building codes in the United States. A visual examination of the data presented indicates that the CFE is only weakly dependent on FSI for FSI values between 25 and 220. A limiting value for CFE is approximately  $30 \text{ kW/m}^2$ . Above this value there are no test materials which would not meet Coast Guard criteria for FSI. It is noted that there are some data points below this value which would meet the FSI criteria and therefore some currently accepted materials would be excluded from usage if a minimum value of 30 for CFE were to be adopted as an acceptance criteria.

The Heat for Sustained Burning (HSB) is plotted against FSI in Figure 8. Again the data is divided into three major classifications. In this case, a limiting value of a minimum of  $3 \text{ MJ/m}^2$  is indicated. However in this case approximately 50% of the materials tested that had acceptable FSI values would be excluded.

Figures 9, 10 and 11 show similar data for Heat for Ignition, Total Heat Release, and Maximum Rate of Heat Release respectively. A minimum value of  $3 \text{ MJ/m}^2$  is indicated for Heat for Ignition. A maximum value of 0.5 MJ is tentatively suggested for Total Heat Release. Additional tests are needed to evaluate the Total Heat Release parameter for a wider range of materials before a significant limiting value can be established using this approach. A maximum value of 5 kW is indicated for the Maximum Heat Release Rate.

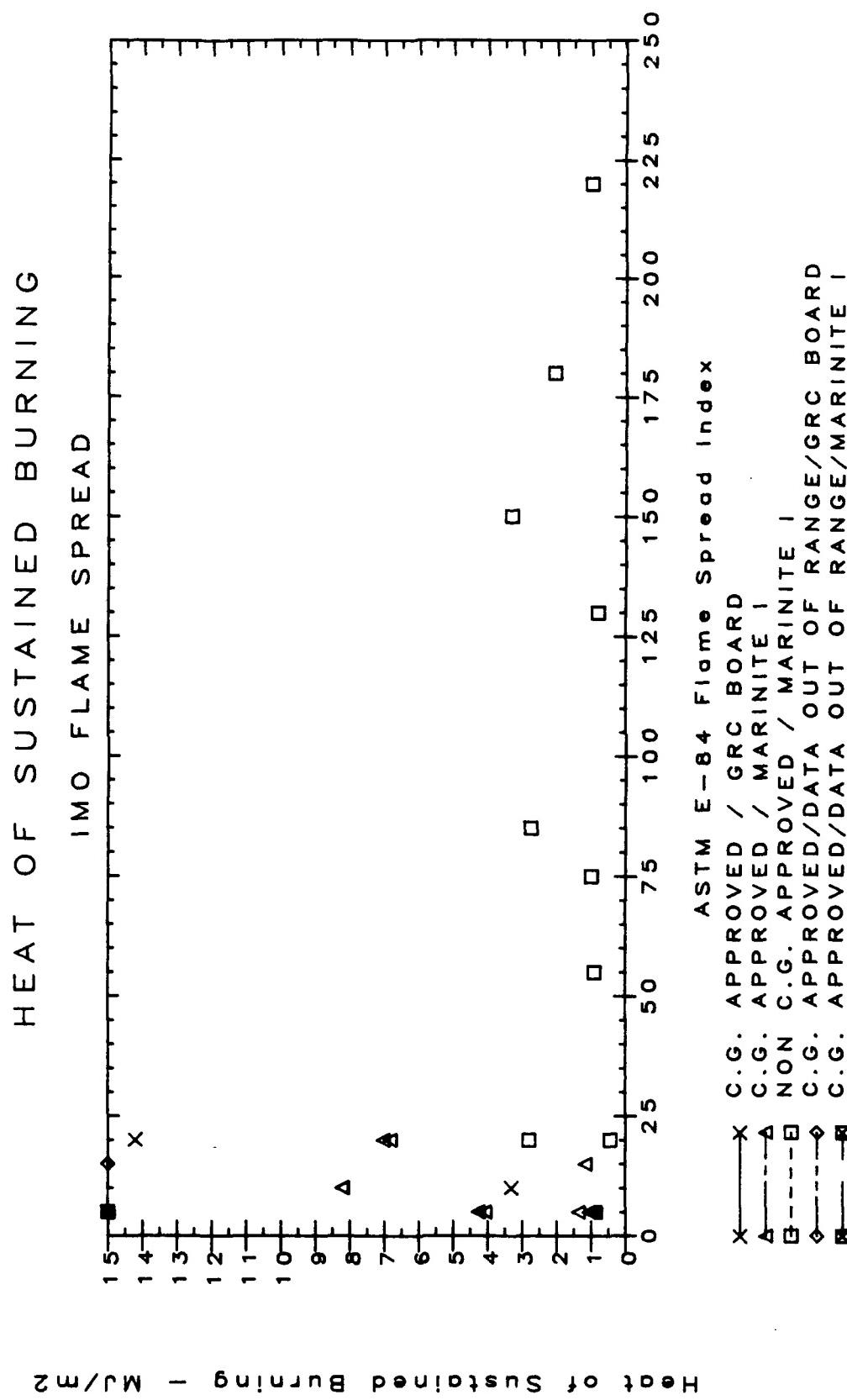


FIGURE 8. HEAT OF SUSTAINED BURNING VS FLAME SPREAD INDEX

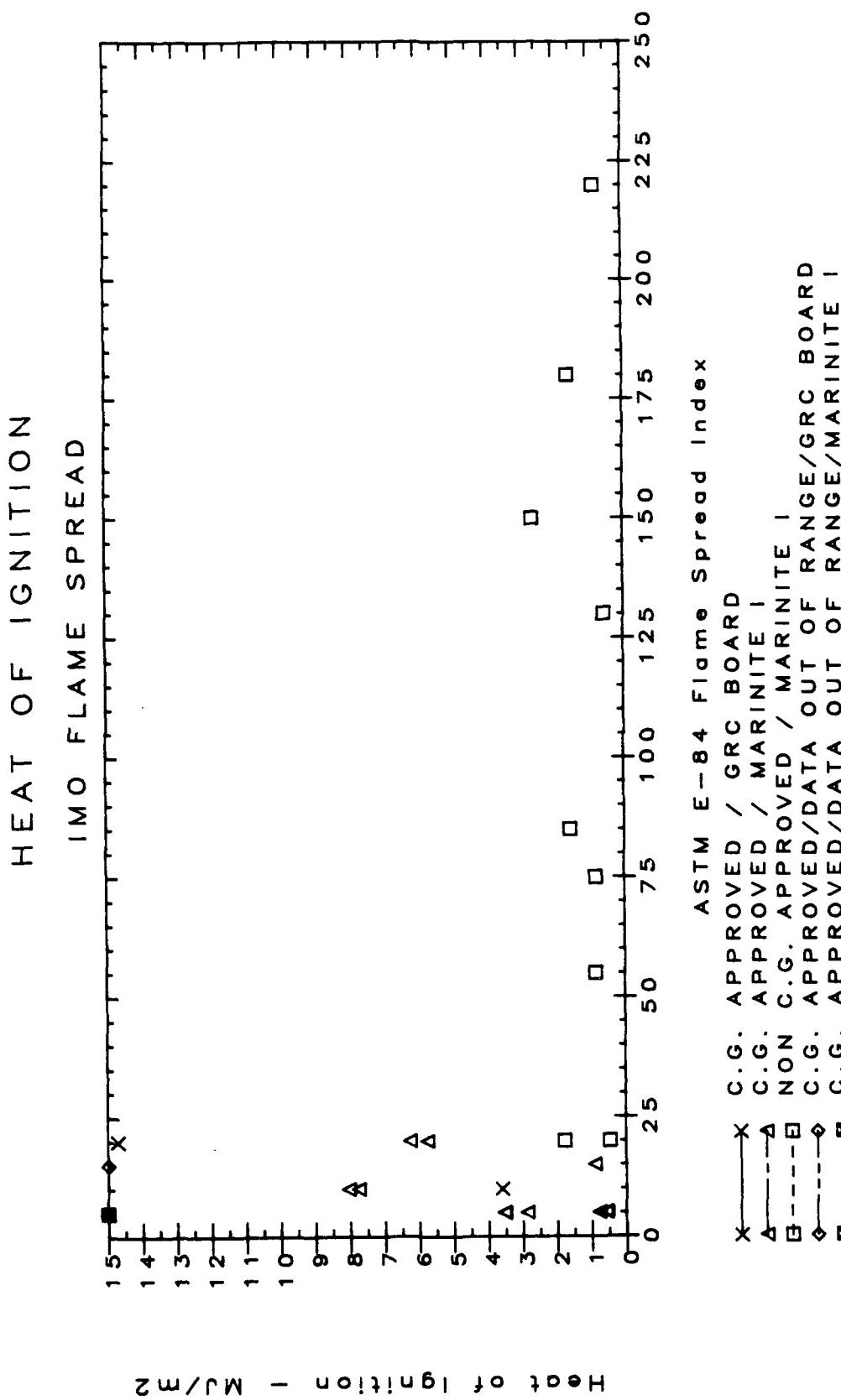


FIGURE 9. HEAT OF IGNITION VS FLAME SPREAD INDEX

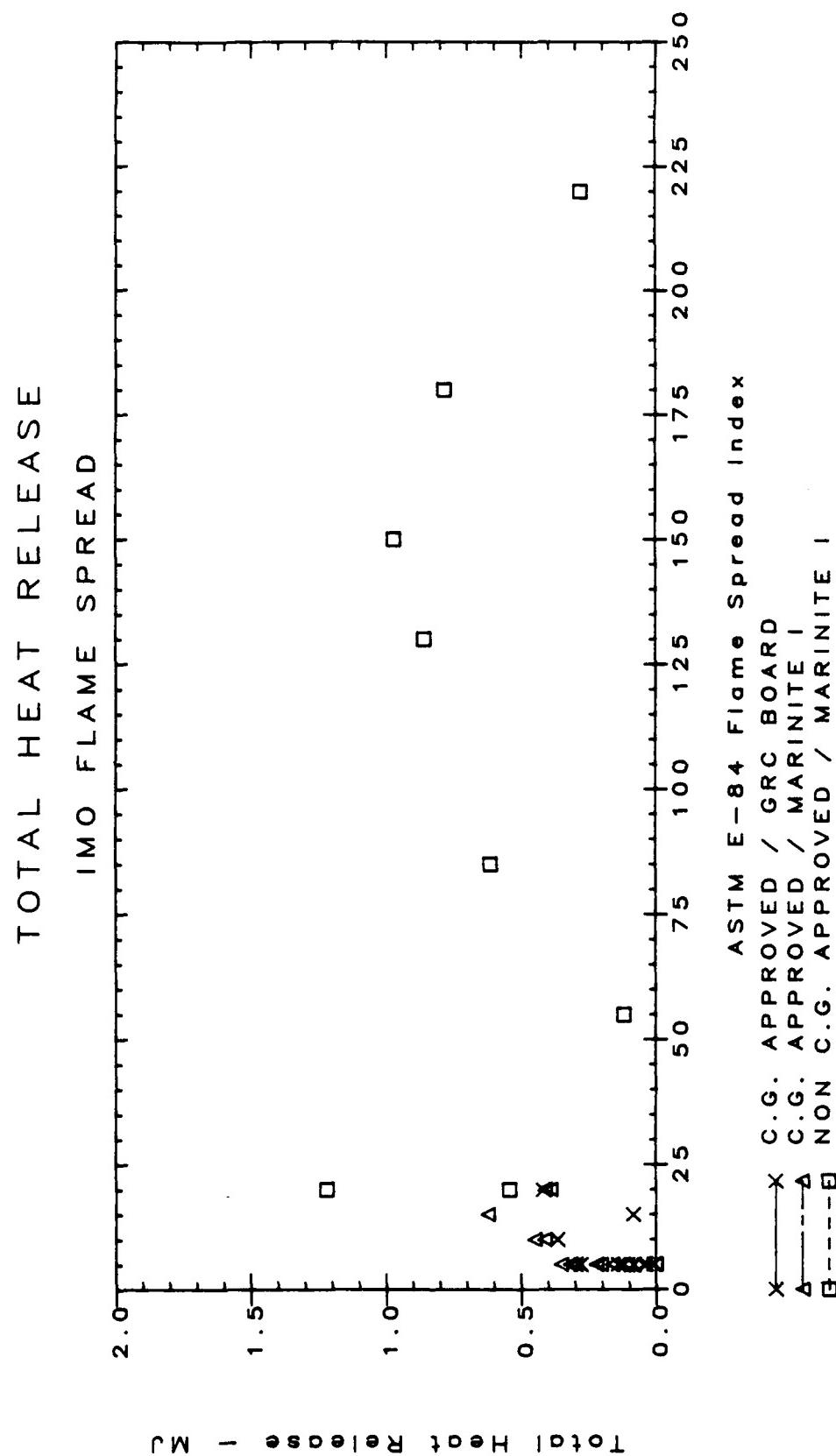


FIGURE 10. TOTAL HEAT RELEASE VS FLAME SPREAD INDEX

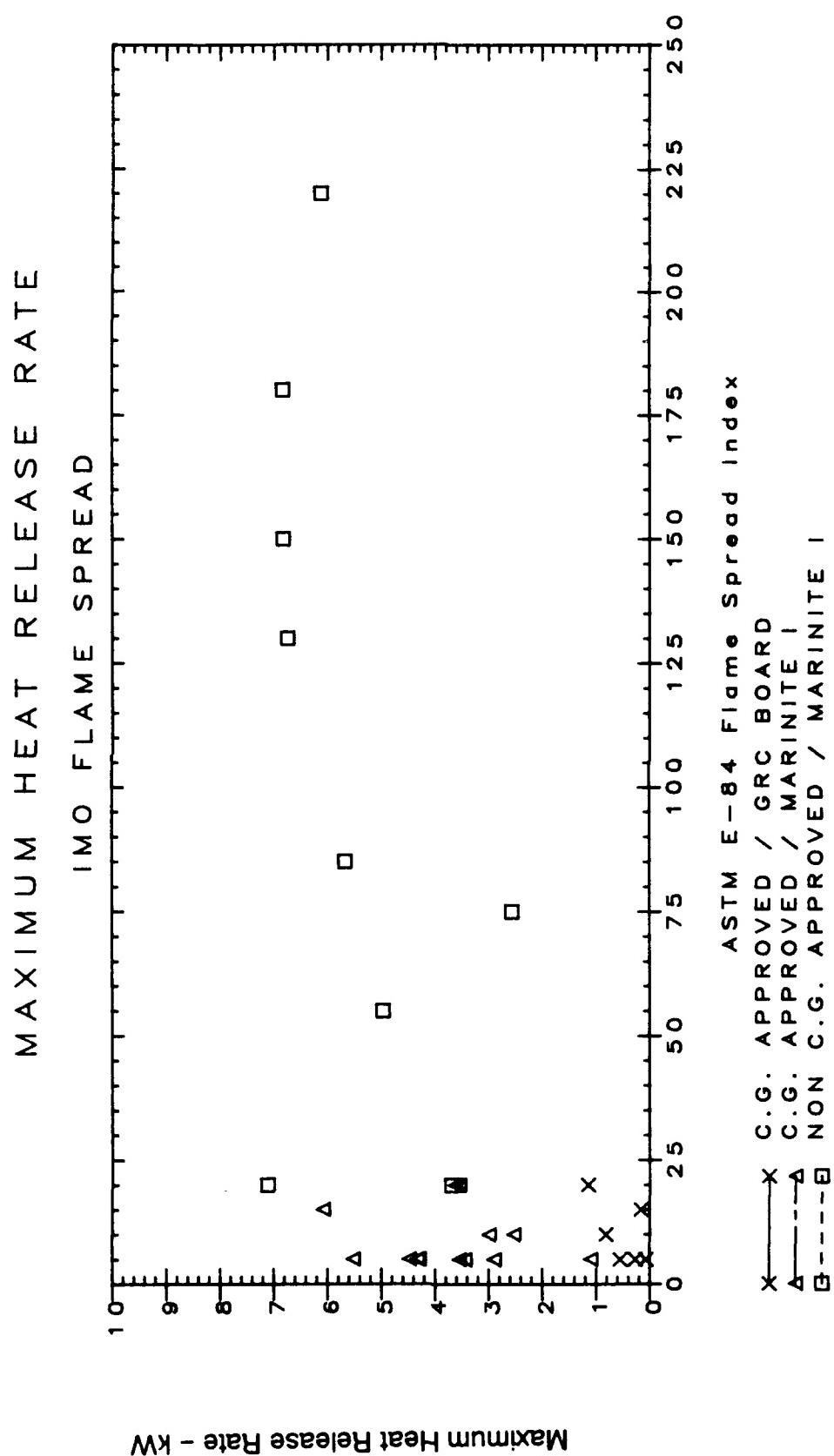


FIGURE 11. MAXIMUM HEAT RELEASE RATE VS FLAME SPREAD INDEX

### 5.1.2 Relative Significance of IMO Test Parameters With Respect to the ASTM E-84 Flame Spread Index

A second comparison that can be developed is to perform a multivariable linear regression analysis in which the FSI is the dependent variable and the IMO test parameters are independent variables. This type of statistical analysis can be used to develop values for the "beta" coefficients. The beta coefficients can be interpreted as non-dimensionalized numbers, independent of scale, which provide information about the relative influence of the independent test parameters on the dependent function. By further normalizing the independent parameters in terms of the least influential variable a scale can be developed which indicates the relative usefulness of measuring a possible parameter in order to use it in the prediction of values for the dependent parameter. Stated somewhat differently the problem is to determine which IMO test parameters provide the most sensitive measure for the prediction of FSI values. If the test parameter has a low index value, it is of lesser usefulness in predicting FSI values.

This type of analysis was made using the data from Table 3 for the wallcoverings. The computations were made using the STAT80 statistical analysis software programs. The results are summarized in Table 5.

This analysis was limited to four of the five IMO test parameters due to a limitation in the number of degrees of freedom resulting from limitations in the available data base. The conclusions should be considered to provide only a qualitative guide to the general trends that may be expected from other materials and/or comparisons with other flammability tests.

Two parameters: Critical Flux at Extinguishment and the Heat for Sustained Burning (HSB) are considered in Table 5A. The interpretation of this analysis is that the CFE is 2.8 times more

**TABLE 5**  
**PARAMETRIC ANALYSIS FOR WALLCOVERINGS**

Independent Parameter	Relative Weight
<b>A. Two Parameter System</b>	
Critical Flux at Extinguishment.....	2.8
Heat for Sustained Burning.....	1.0
<b>B. Four Parameter System</b>	
Critical Flux at Extinguishment.....	9.3
Heat for Sustained Burning.....	1.0
Maximum Rate of Heat Release.....	3.7
Total Heat Release.....	11.6
<b>C. Three Parameter Systems</b>	
Critical Flux at Extinguishment.....	8.8
Heat for Sustained Burning.....	1.0
Total Heat Release.....	7.5
Critical Flux at Extinguishment.....	8.6
Heat for Sustained Burning.....	1.0
Maximum Rate of Heat Release .....	3.5

influential in determining the FSI than the HSB. Consideration of the four IMO parameters listed in Table 5B would suggest that this ratio increases to 9.3 to 1 when all four parameters are considered, and that the combination of CFE and Total Heat Release accounts for 82% of the FSI value. It is noted that the HSB parameter represents less than 4% of the effect. Similarly, for the two three-parameter systems (Table 5C), the major effects are associated with the CFE and either the Total Heat Release or the Maximum Rate of Heat Release. Again the HSB appears to contribute only 6 to 8% to the total effect.

The national test used by the U.S. Coast Guard is the ASTM E-84 test method which utilizes the concept of a flame spread index in order to rank materials in order of their anticipated relative flammability under real fire conditions. The IMO Spread of Flame A.564(14) test, as modified by recommendations contained in FP 32/WP.9, has reduced the original set of five "derived fire characteristics" to two. The analysis outlined above is a technique that can be used to assist in determining whether the deletion of a specific derived fire characteristic will substantially affect the rank ordering of interior finish materials relative to the current Coast Guard standards for flammability.

#### 5.1.3 The Reproducibility of the IMO Test Parameters

An estimate of the reproducibility of the IMO test parameters can be made by comparing the U.S. Coast Guard and U.L. results in Table 3. The U.L. data is in parentheses adjacent to the U.S. Coast Guard data. The reproducibility for the Critical Flux at Extinguishment parameter is good. The reproducibility of the Maximum Heat Release Rate and the Total Heat Release value is reasonable. It is noted that with two exceptions, M2 and M9, the U.L. values were obtained from only one test sample.

## 5.2 IMO TEST PARAMETERS

Comments on the problem areas associated with the test procedures are outlined as follows:

### 5.2.1 Critical Flux at Extinguishment

The Critical Flux at Extinguishment depends on the ability to define a flame front at the center line of the test sample. For some of the materials evaluated, it was not always possible to accurately assess the position of the flame front. For laminated test specimens, it was not unusual to have the flame front proceed by discontinuous steps above and below the center line. Also, flame holding near the bottom and top of the test sample occurred for some materials. Because of these problems, it was necessary to consider the extinction distance as being that point to which a stabilized flame had advanced. For the coatings this problem was less apparent. The PVC wallcoverings were intermediate in this type of behavior. The extent to which the flame propagation mechanism affects the results for CFE should be assessed in a round robin evaluation of the test method using "difficult" materials.

### 5.2.2 Heat for Sustained Burning

Because the heat for sustained burning involves an evaluation of the position of an advancing discontinuous flame front, the problems outlined in the previous section also affect the precision of this measurement. Again, it is suggested that a systematic program may be needed to determine whether the judgement of experienced test personnel can be relied upon to produce consistent test results for "difficult" materials.

### 5.2.3 Heat for Ignition

For test samples applied to GRC board much difficulty was experienced in developing ignition. Most of these materials did not ignite under the imposed test conditions. The most probable cause for this effect is the relatively high thermal conductivity

of the substrate. Heat transfer to the substrate is more efficient in both cooling the exposed surface of the test sample and reducing the decomposition of the adhesives at the material/substrate interface. For Marinite I, the lower thermal conductivity results in delamination of the material from the substrate and subsequent ignition. For test samples applied to Marinite I, the ignition process was usually delayed but when it occurred it occurred over a relatively broad region ranging from 0 to 200 mm almost instantaneously.

#### 5.2.4 Total Heat Release

Several problem areas arose in the determination of the total heat release. First, for many samples the explosive delamination or the fall-off of material from the surface reduced the combustible fuel load subjected to the imposed heat flux from the radiant panel. Having less fuel the total heat that could go up the stack was reduced. A second problem was the correction necessary to account for the cooling effect of the test sample. The procedure used for this report was to assume that the applied test material was a thin sample and that the rate of thermal heating to the substrate was independent of the applied material. This assumption allowed the development and use of inert substrate test specimens to calibrate the cooling effect. Although this approximation is reasonable for the materials tested, other more complex constructions and thick slabs of materials may require a different treatment. Finally, it was observed that occasionally the part of the smoke generated by the sample would bypass the stack on the test apparatus. The extent of the heat loss caused by the specific design of the stack should be determined.

#### 5.2.5 Maximum Heat Release Rate

Two problems were apparent in the evaluation of the Maximum Heat Release Rate. First the effect of sample cooling should be evaluated. The magnitude of this effect was determined to be approximately 50% of the recorded value for one of the samples

tested. Secondly, the thermal lags in the stack thermocouple system may significantly alter the values obtained.

For several test materials, the maximum rate of heat release was sharply spiked resulting from short burning times. To obtain accurate values, the sensitivity of the system should be increased.

### 5.3 PASS/FAIL CRITERIA

Based on the results obtained on this project, the pass/fail criteria outlined in Table 6 are recommended. These criteria are based on the limiting values estimated from the results outlined in Section 5.1.1. The relationship between these criteria and other methods of developing pass/fail criteria such as a rank ordering of materials is not established. Also as indicated in Section 5.1.2 the use of all five parameters will increase the assurance that materials evaluated using the IMO Spread of Flame Test will have flammability characteristics equivalent to those specified by current Coast Guard Standards.

TABLE 6  
PASS/FAIL CRITERIA

Critical Flux at Extinguishment .....	30 kW/m <sup>2</sup>	(Minimum)
Heat for Sustained Burning .....	3 MJ/m <sup>2</sup>	(Minimum)
Heat for Ignition .....	3 MJ/m <sup>2</sup>	(Minimum)
Maximum Heat Release Rate .....	5 kW	(Maximum)
Total Heat Release .....	0.5 MJ	(Maximum)

These results are to be compared to those specified in FP 33/23, Annex 2 (Table 7). For bulkhead finish materials the pass/fail criteria recommended above are more stringent than those specified. However, it should be noted that of eleven materials which would be acceptable using current USCG regulations (ASTM E-84 less than or equal to 20), only four would pass using the currently specified IMO values.

ANNEX 2

## SURFACE FLAMMABILITY CRITERIA

Bulkhead, wall and ceiling linings				Floor coverings			
CFE kW/m <sup>2</sup>	Q <sub>s</sub> b MJ/m <sup>2</sup>	Q <sub>t</sub> MJ	q <sub>p</sub> kW	CFE kW/m <sup>2</sup>	Q <sub>s</sub> b MJ/m <sup>2</sup>	Q <sub>t</sub> MJ	q <sub>p</sub> kW
≥ 20.0	≥ 1.5	≤ 0.7	≤ 4.0	—	≥ 7.0	≥ 20.25	≤ 1.5
							≤ 7.0

Where CFE = Critical flux at extinguishment;

Q<sub>s</sub>b = Average heat for sustained burning;

Q<sub>t</sub> = Total heat release;

q<sub>p</sub> = Peak heat release rate.

\*\*\*

TABLE 7

SURFACE FLAMMABILITY CRITERIA FROM FP 33/23, ANNEX 2

## **6.0 CONCLUSIONS**

6.1 Some interior finish materials currently accepted for use by the U.S. Coast Guard exhibit burning characteristics not presently addressed in Resolution A.564(14). These characteristics include burning of isolated areas above and below the specimen center line, momentary "cool" flames across the sample surface, and explosive delamination of the applied finish material. The existence of these characteristics limit the precision of measurement for the position of the flame front.

6.2 Procedures for determining rate of heat release that require either clarification or modification include the following:

6.2.1 A procedure is needed to account for the cooling effect of the test sample at time of insertion. For thin films applied to a noncombustible substrate, this effect can be estimated by using rate of temperature rise data for the noncombustible substrate.

6.2.2 The effects of the bypass of fire gases on the outside of the stack and the fall-off and explosive delamination of materials from the surface of the test sample should be evaluated.

6.2.3 The response rate for the stack thermocouple system is slow relative to the rate of heat release for many of the materials evaluated. The effect of this lack of response on the precision of measurement should be evaluated.

6.3 Limiting values for pass/fail criteria for the IMO test parameters can be assigned based on correlations with the ASTM E-84 Flame Spread Index (FSI) for the materials of interest. Assuming the U.S. Coast Guard values for flame spread (ASTM E-84, FS = 20), the limiting pass/fail criteria for the IMO test parameters become those listed in Table 6.

6.4 A qualitative assessment of the relative influence of individual IMO test parameters on the estimate of fire hazard can be made using a multivariable linear regression analysis. An assessment using PVC wallcovering data indicates that the Total Heat Release and the Maximum Rate of Heat Release should be included in the required IMO test data. It also suggests that the Heat for Sustained Burning is of limited value for this class of materials.



**APPENDIX A**  
**DESCRIPTION OF MATERIALS**

## APPENDIX A

### LIST OF MATERIALS USED FOR THE IMO A.564(14) TEST EVALUATION PROJECT

#### I. LAMINATES

M1 - LAMINATE	Westinghouse Electric Corporation--MICARTA TYPE PFR-1. Thickness 1.25 mm. Weight 2.0 kg/m <sup>2</sup> .
M2 - LAMINATE	Ralph Wilson Plastics. Melamine TYPE 607. Thickness 1.57 mm. Weight 2.73 kg/m <sup>2</sup> .
M3 - LAMINATE	Ralph Wilson Plastics. Melamine TYPE 604. Thickness 0.79 mm. Weight 1.12 kg/m <sup>2</sup> .
M15 - LAMINATE	CW23-23 TYPE 335 with 205 BACKER KOPPERS G4422/4400 adhesive.
M16 - LAMINATE	CW23-23A TYPE 350 WITH 205 BACKER KOPPERS G4422/4400 adhesive.
M17 - LAMINATE	CW23-23B TYPE 107 with 205 BACKER KOPPERS G4422/4400 adhesive.

#### II. COATINGS

M4 - COATING	Marathon Industries Inc. Acrylic coating TYPE EC102. Application rate 2.37 m <sup>2</sup> /l.
M5 - COATING	Marathon Industries Inc. General purpose coating 590 LO PERM. Application rate 0.74 m <sup>2</sup> /l.
M6 - COATING	H.B.Fuller Company G.P. coating 30-55. Application rate 1.48 m <sup>2</sup> /l.
M21 - COATING	590 LO PERM, 01-1373-520. Troweled application. Application rate- 0.62 m <sup>2</sup> /l

## I. LAMINATES (cont'd)

M22 - COATING I.D. 102 PERM SURE, 01-1373-520. Troweled application.  
Application rate- 2.0 m<sup>2</sup>/l

M23 - COATING M-04, 01-1373-520.  
Application rate 0.35 m<sup>2</sup>/l

## III. PVC WALLCOVERINGS

M8 - WALLCOVERING Columbus Coated Fabrics Division of Borden Chemical.  
Vinyl film wallcovering TYPE K-2L.  
Thickness 0.38 mm. Weight 0.27 kg/m<sup>2</sup>.

M9 - WALLCOVERING B.F.Goodrich Company. Embossed vinyl wallcovering. Type I-G.  
Thickness 0.53 mm. Weight 0.35 kg/m<sup>2</sup>.

M10 - WALLCOVERING Diversitech General (General Tire and Rubber Company)  
Vinyl film covering SK822.  
Thickness 0.15 mm. Weight 0.19 kg/m<sup>2</sup>.

M18 - WALLCOVERING Smooth white vinyl with nonwoven back.  
BORDENS E8825 CASCOVIN adhesive.  
Thickness 0.64 mm.

M19 - WALLCOVERING Tan embossed vinyl with fabric back.  
B.F.GOODRICH A-848-B KOROSEAL adhesive.  
Thickness 0.525 mm. Weight 0.89 kg/m<sup>2</sup>.

M20 - WALLCOVERING I.D. NONE. 01-1373-520. CASCOVIN adhesive. Brown vinyl.

## IV. SPECIAL FINISHES

M7 - SPECIAL FINISH Claremont Company Inc. Fiberglass reinforced finish. TUFFSKIN 1613.  
Thickness 0.25 mm.  
Weight 0.12 kg/m<sup>2</sup>.

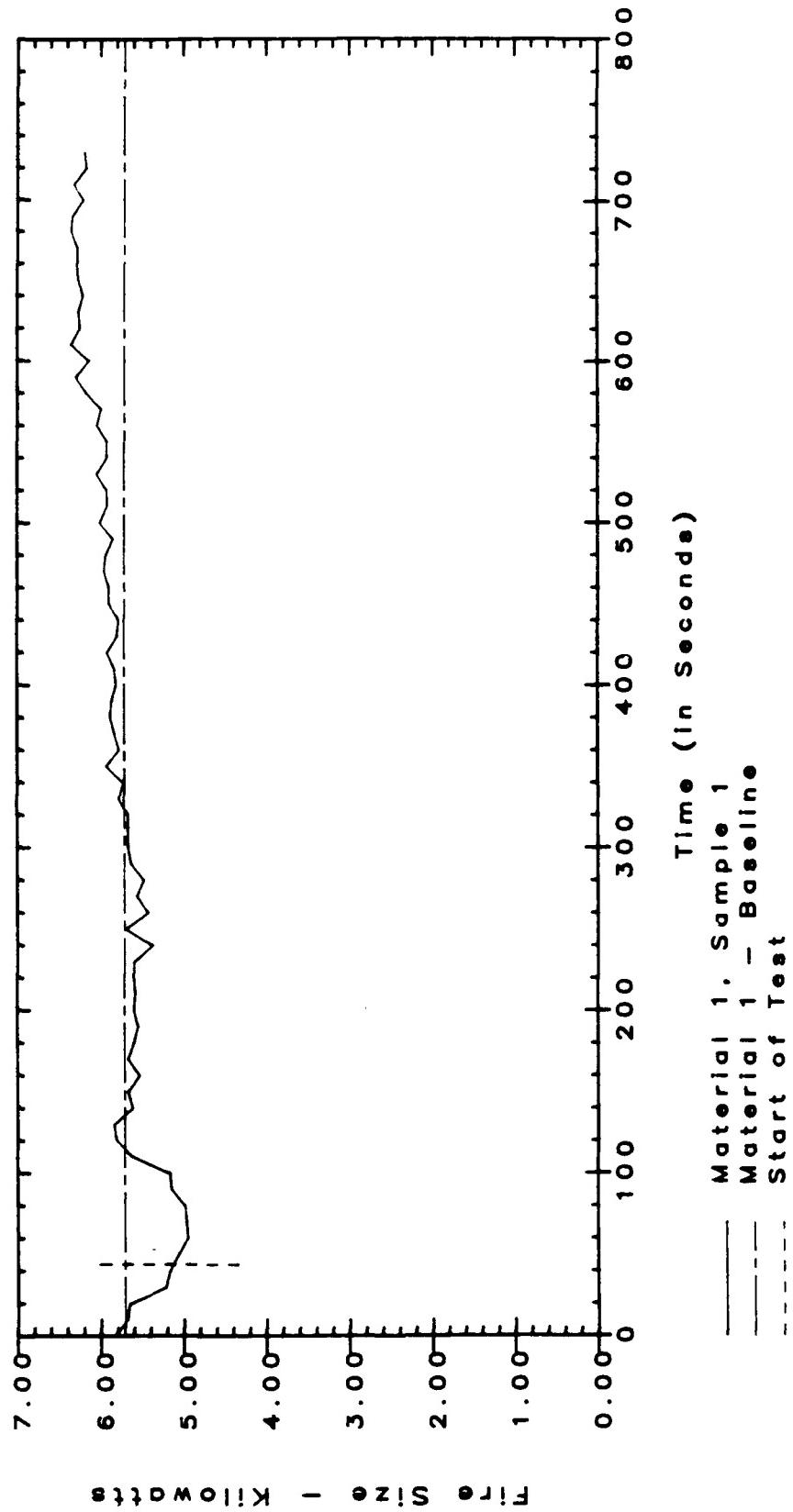
**APPENDIX B-1**

TEST: M1S1SP1 Specimen Number 1  
DATE: 7 November 1986  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
25	50	Spontaneous explosive delamination up to 200 mm
40	150	Laminate separating from backing
45	200	Original popping is charred; heavy smoke; no flame; char line
75	0-250	Complete black char; pieces are exploding and separating from backing; heavy smoke
120		Explosive delamination; no flame
130	300	Smoke
160	50-150	Lamination separating from backing on top of sample
170	350	Slight bubbles on center line
180	300	Black char on vertical line; bubbles popping in front
220		Lamination holding together with slight surface cracking that is separating from backing
260	400	Slight bubbles on center line, 3.18 mm diameter on material surface
285	200	Material still separating from backing on top of sample
295		Char line vertical with slight smoke
330		No flame
380	200	Progression of separation of char has ceased
400	450	Black char line, slight bubbles on center line
490		Smoke is at a minimum; very light
495		Little progression of bubbles on center line
520	250	Laminate material separated from backing
580	425	Smoke and bubbling have ceased
590	400	Char line has ceased
630		Laminate has separated on top of sample with crack on 100 mm
645	400	Char line
660	475	Last bubbles; no smoke; no flame

IMO FLAME SPREAD TEST



B-1.2

TEST: M1S2SP1 Specimen Number 2  
DATE: 10 November 1986  
MATERIAL: High Pressure Laminate

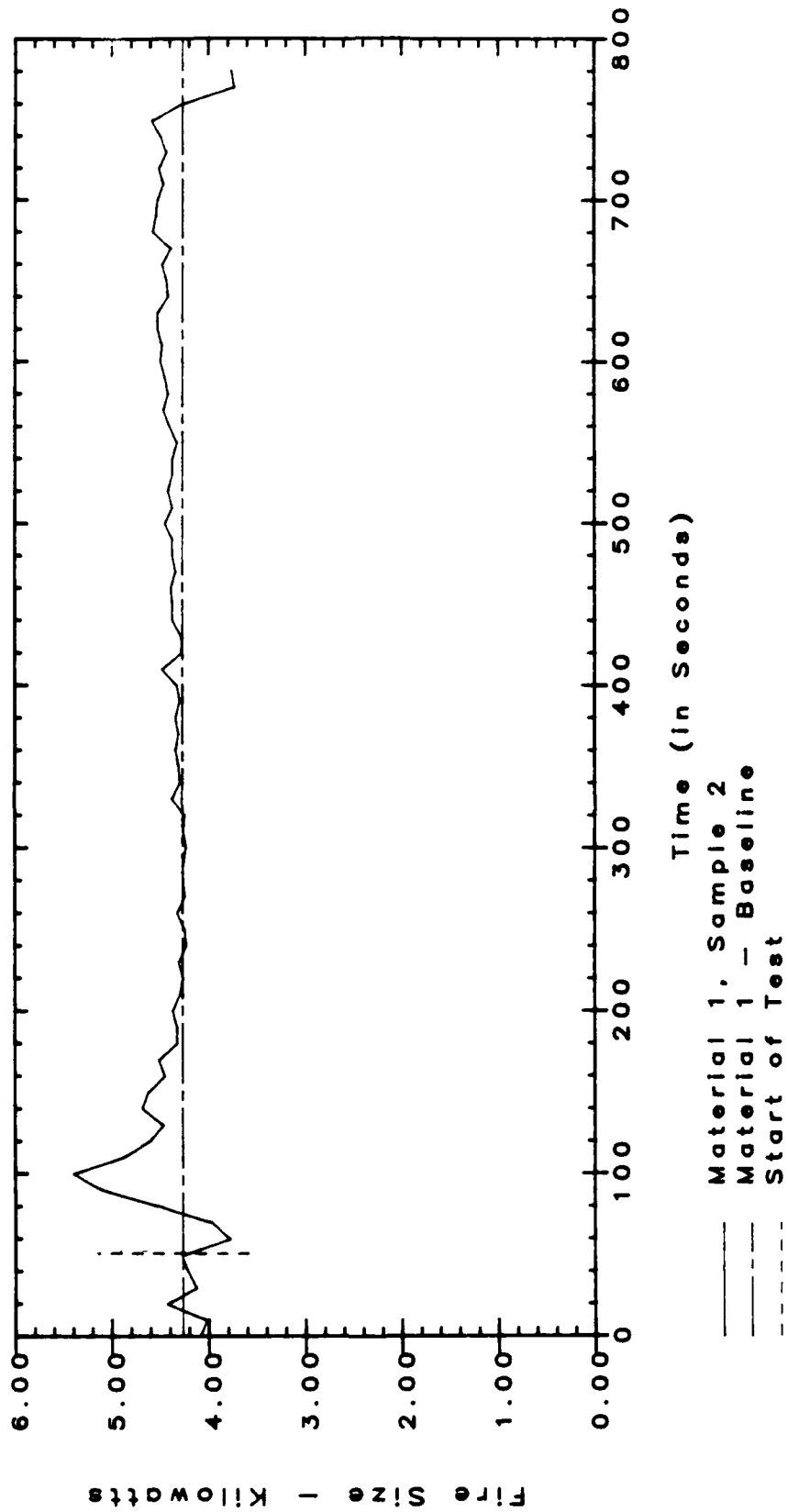
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5	25	Spontaneous charring at impinging pilot flame
20	50	Explosive delamination
35	0-100	Flames across surface
50	120	Charred surface
55	200	Charred surface
60	250	Charred surface
65-80	0-150	Alligatoring; light flame at pilot; explosion lifted laminate away from backing
90	250	Surface complete black char and alligatoring
110	100	Fire out
125		Moderate smoke
135		Char
150		Explosive delamination ceased
155	300	Complete black char and alligatoring
165		Moderate smoke, some laminate separated from backing

Sample Description at End of Test

230	0-50	No lamination; impinging flame on back
250	100-300	Alligatoring on surface with material separating from backing
260		50-100 Small portion of laminate popped off original backing
265	300-400	Surface bubbles

IMO FLAME SPREAD TEST



B-1.4

TEST: M1S3SP1 Specimen Number 3  
 DATE: 12 November 1986  
 Material: High Pressure Laminate

Time (sec)	Distance (mm)	Remarks
27	40	Spontaneous explosive delamination
40	0-100	Starting to char
55		Heavy smoke; top of bubbles turning black
62		Large explosion that lifted up lamination
67	200	Heavy smoke
85	0-50	Fire off and on, burning the lamination in area of large explosion
105	300	Char line
110		Fire out; heavy smoke
120	0-250	Alligatoring
135		Heavy smoke; no flame
145		Explosive delamination has ceased to a minimum
180	0-300	Heavy smoke and alligatoring; separating from backing
190	0-150	Material turning white; char
198	350	Black char line
210	0-150	Material separating from backing at top and bottom and shrinking in size
220	0-150	Flame on top of sample off and on; light flame; light smoke
235		Flame; light smoke
245	200	Flame has progressed to this point
250		Dark red fire along center line
270	25-200	Material still shrinking at top and bottom of sample
280	0-25	Material separated from end of sample surface
290		Flame very light
310		Dark red in color; laminate is charred
355		Light flame; barely visible, not attached to surface
380	400	Char line
390	400-450	Small bubble on surface
410		Very little flame
490	0-25	White char and separation
495	25-50	Separation the width of sample
500	50-200	Separated from top and bottom of sample; burning with very light flame
520	200-400	Dark black char
525	400-450	Small bubbles
540	450-750	Smooth original surface; no defects
555		Burning material is dark red in color; surface material turning white; some pieces flaking off

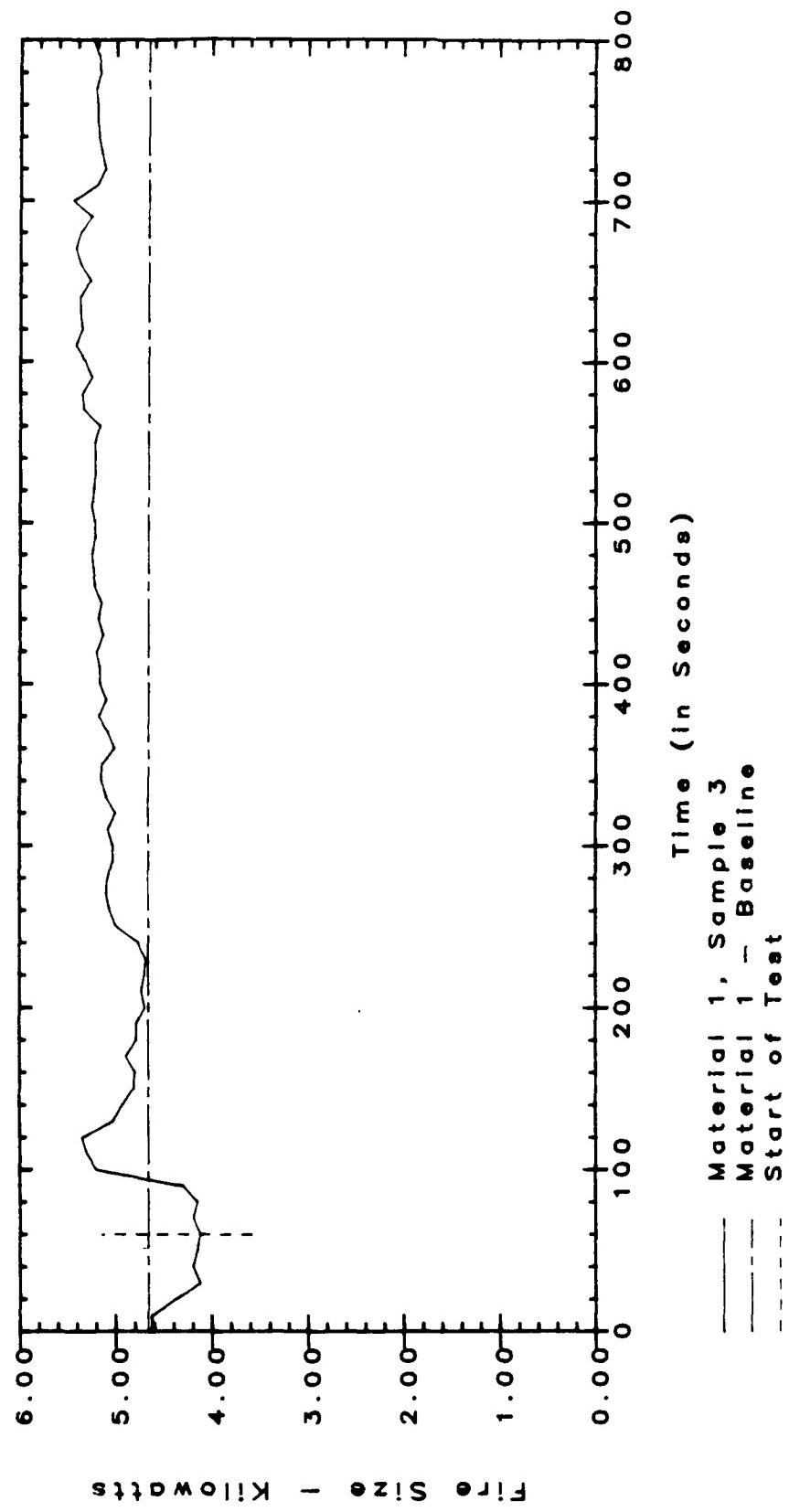
TEST: M1S3SP1 Specimen Number 3 (cont'd)  
DATE: 12 November 1986  
MATERIAL: High Pressure Laminate

Time (sec)	Distance (mm)	Remarks
670		Flame out at this time; red material has fallen off
700		No further progression

Sample Description at End of Test

730	0-25	Burnt laminate material
735	25-100	Original backing with no material left
740	100-200	Burnt laminate material that has separated
155	200-425	Dark brown char line with small alligatoring
765	425-475	Light bubbles on surface
780	475-750	Smooth original surface; no defects

IMO FLAME SPREAD TEST



B-1.7

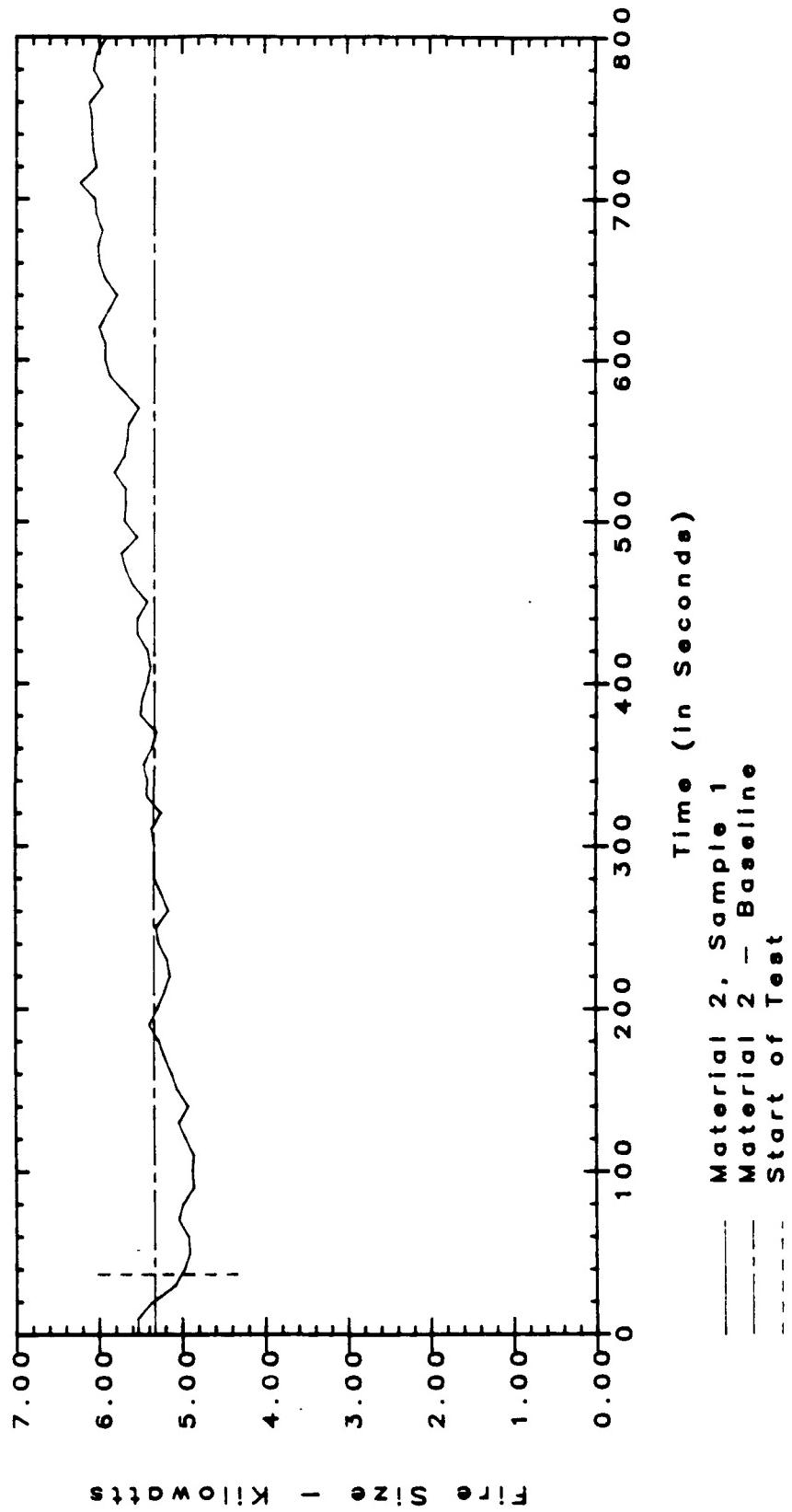
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TEST: M2S1SP1 Specimen Number 1  
DATE: 7 November 1986  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
20	50	Spontaneous explosive delamination up to 200 mm
40	200	Complete black char
100	200-300	Turning brown; explosive delamination at a minimum
170	350	Explosive delamination has ceased
190	0-50	Material starting to separate from surface; surface brown in color
285	0-150	Laminate material has separated from backing
300	200-350	Black char
310	350-400	Light black vertical char line
320	400	Char line
390	50-150	Laminate material separated
540		Slight surface flame; laminate separated from sample
570	50-200	Light flame flickering; some laminate falling off
12 min, 10 sec	450	Char line forward is smooth and has original surface
13 min, 10 sec.	0-250	Charred material turning white
15 min, 10 sec		Very little flame; material flaking off backing and has turned white; char line has progressed
17 min, 10 sec	0-250	Laminate has separated from backing
17 min, 20 sec	250-350	Dark char
17 min, 30 sec	350-450	Light char and bubbling
18 min 45 sec		Flickering flame around laminate; very little left on original surface
18 min, 45 sec		No flame spread; residue ignited on laminate and separated from backing
19 min, 20 sec		Large piece of laminate fell off
19 min, 40 sec		Forward bubbles
20 min, 15 sec		Flame very light on residue of laminate; separated from backing
22 min, 0 sec	0-250	Little material left on backing
22 min, 1 sec		Still light flickering flame
23 min, 45 sec	0-200	Laminate material around center line has fallen off
24 min, 10 sec	500	Final position of bubbles
24 min, 50 sec		Flame out; no more bubbling

IMO FLAME SPREAD TEST



TEST: M2S2SP1 Specimen Number 2  
 DATE: 10 November 1986  
 MATERIAL: High Pressure Laminate

Time (sec)	Distance (mm)	Remarks
5	25	Spontaneous explosive delamination at pilot flame area
30	150	No fire
35	200	Top of bubble turning black with char; no flame; heavy smoke
50	250	Heavy smoke; no flame
75	300	Explosive delamination
95	0-200	Dark black char; explosive reaction at pilot
100	200-300	Light brown char; surface is alligated
110		Bubbles bursting
120		Moderate smoke
145	350	Surface bubbles
155	0-100	Flame at impinging pilot
180		Flame; material starting to peel off back; flame is yellow and burning the lamination; does not appear to be gas
195		Flame starting to die out
210	200	Progressing rapidly; flame shooting up to exhaust hood 152.4 mm on center line; laminate material flaking off in one large chunk approximately 200 mm in diameter; has separated off 25.40 mm from backing
245	400	Bubbles and light brown char line
270	200	Flame semi-diminished
285	200-250	Flame extinguished
360	200	Lamination separated from backing along center line; large pieces hanging over; alligatoring and charring
370	200-350	Dark char
380	350-425	Light brown char and surface bubbles
540	0-150	No smoke; no flames; material has delaminated from original backing almost completely
550	150-250	Lamination has separated from backing
555	250-350	Dark brown char
560	350-450	Light brown char and bubbles
625	50	Small flame on piece of lamination that has separated from the back; small flickering; a piece of material fell

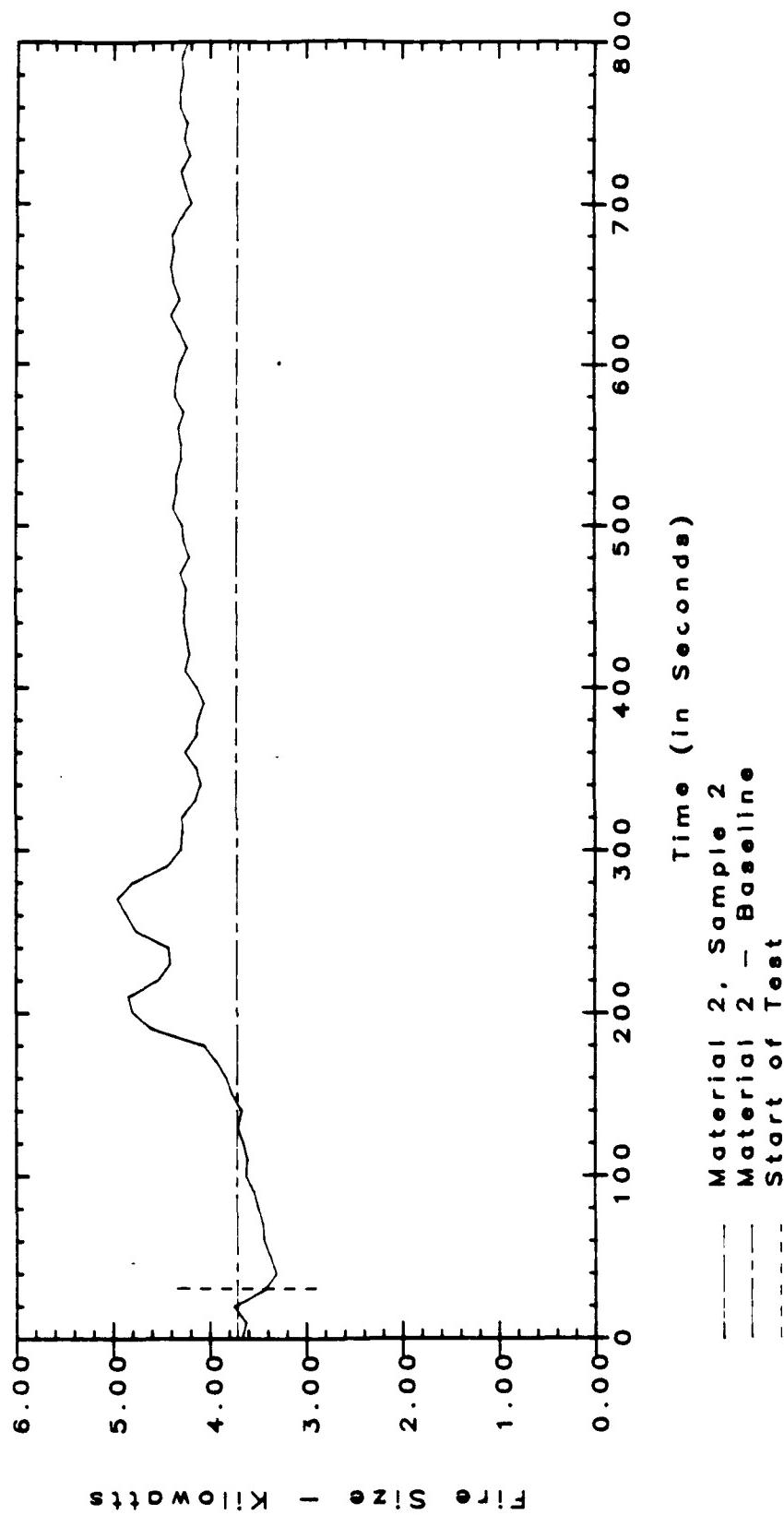
TEST: M2S2SP1 Specimen Number 2 (cont'd)  
DATE: 10 November 1986  
MATERIAL: High Pressure Laminate

Time (sec)	Distance (mm)	Remarks
690		Flame-out on small pieces of laminate; appears to be surface gas off material that was burning by impinging flame

Sample Description at End of Test

700	0-200	No material
720	200-300	Black char
730	300-400	Dark brown char
735	400-450	Light brown char with surface bubbles

IMO FLAME SPREAD TEST



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TEST: M2S3SP1 Specimen Number 3  
 DATE: 12 November 1986  
 Material: High Pressure Laminate

Time (sec)	Distance (mm)	Remarks
25	40	Spontaneous explosive delamination
30	50	Spontaneous explosive delamination
32	150	Heavy smoke
37	200	Surface turning brown to black char
45		No flame
60	250	Explosive delamination; heavy smoke 12.70 mm - 25.40 mm diameter; black char
90	300	Large explosion of bubbles
100		Material experiencing extensive explosive delamination; heavy smoke
135		Bubbles that exploded have exposed backing of material
145	0-300	Complete black char line
155	300-350	Light brown char
158	100	Flame now going up into stack; non attached
180	150	Orange flame across surface of material
200		Flame starting to die out and flicker
220		Still flickering; flame height 25.40 mm - 50.80 mm
235	0-200	Flame travel to 200mm
255	150-200	Flame increased width and vigor
300	200	Flame flicker; flame out
330	0-200	Explosive delamination has separated from backing
345	200-350	Dark brown char
355	350-400	Light brown char; no flame; little smoke
475	0-200	Dark black char that has separated from material
485	200-350	Dark brown char
495	350-400	Light brown char
500	400-750	Smooth original surface
505	0-50	Surface flame; burning laminate material
510	0-200	Material separated along center line
530		Separated along bottom of sample holder
540		Flame flickering; light in color
555		Very light smoke
570	0-200	Burnt material starting to turn white with char and flaking off sample
590		Flame still flickering
680	0-50	Flame still flickering
700		Pieces are falling off sample
720		Flames are burning laminate material from explosion at beginning

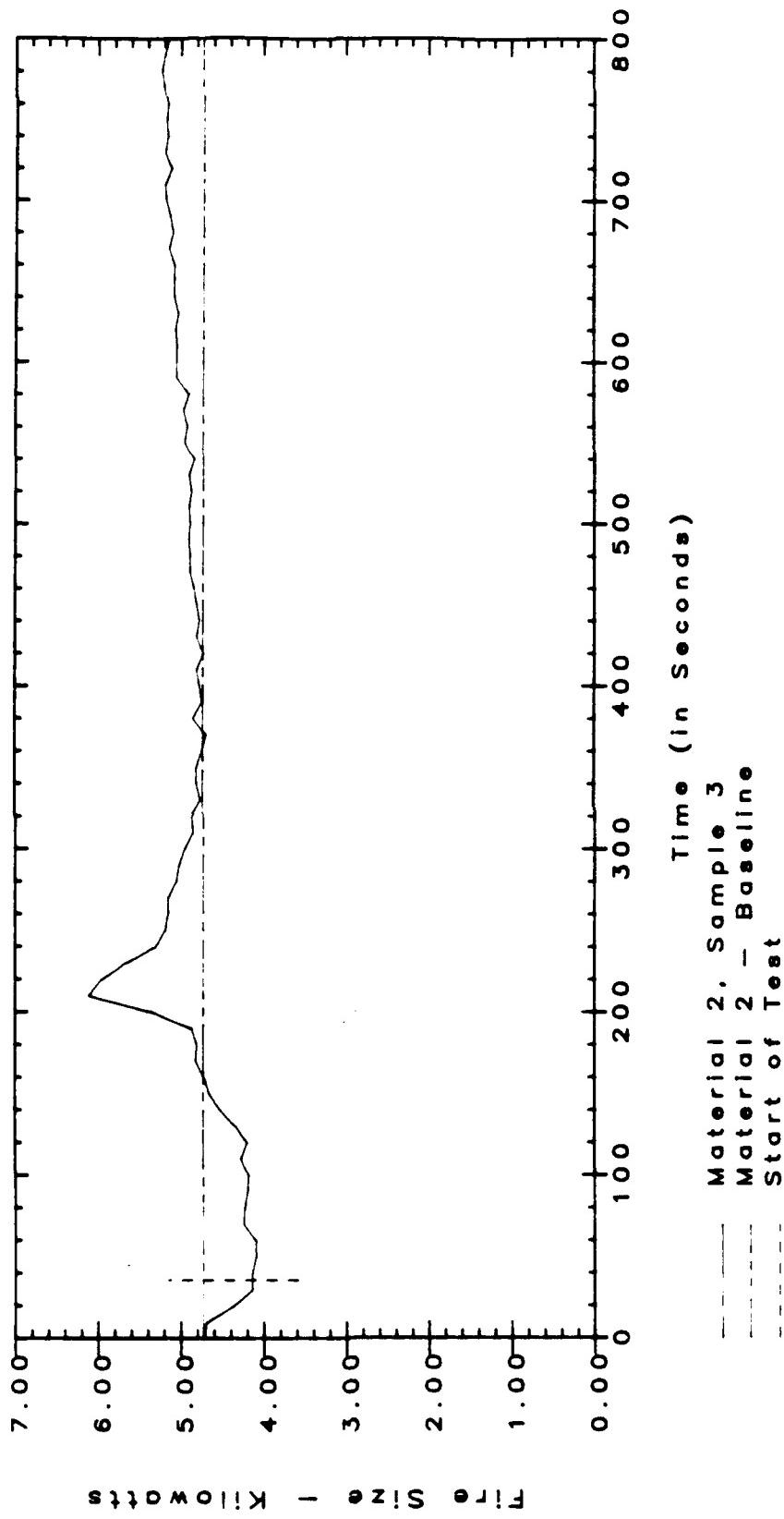
TEST: M2S3SP1 Specimen Number 3 (cont'd)  
DATE: 12 November 1986  
MATERIAL: High Pressure Laminate

Time (sec)	Distance (mm)	Remarks
785		Flame still flickering; white with char
800		Most has separated from backing
880	200	New flame flickering
900	0-50	Flame still flickering
925	200-250	Flame spread; flickering unsteady
945		Crack along center line is separating
1035		Flickering flame out

Sample Description at End of Test

1055	0-100	No material on backing
1065	100-400	Material separated on center line and dark black char; exposed backing
1080	400-450	Light brown char on center line
1100	450-750	Smooth original surface; no defects

IMO FLAME SPREAD TEST



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TEST: M3S1SP1 Specimen Number 1  
DATE: 7 November 1986  
MATERIAL: High Pressure Laminate

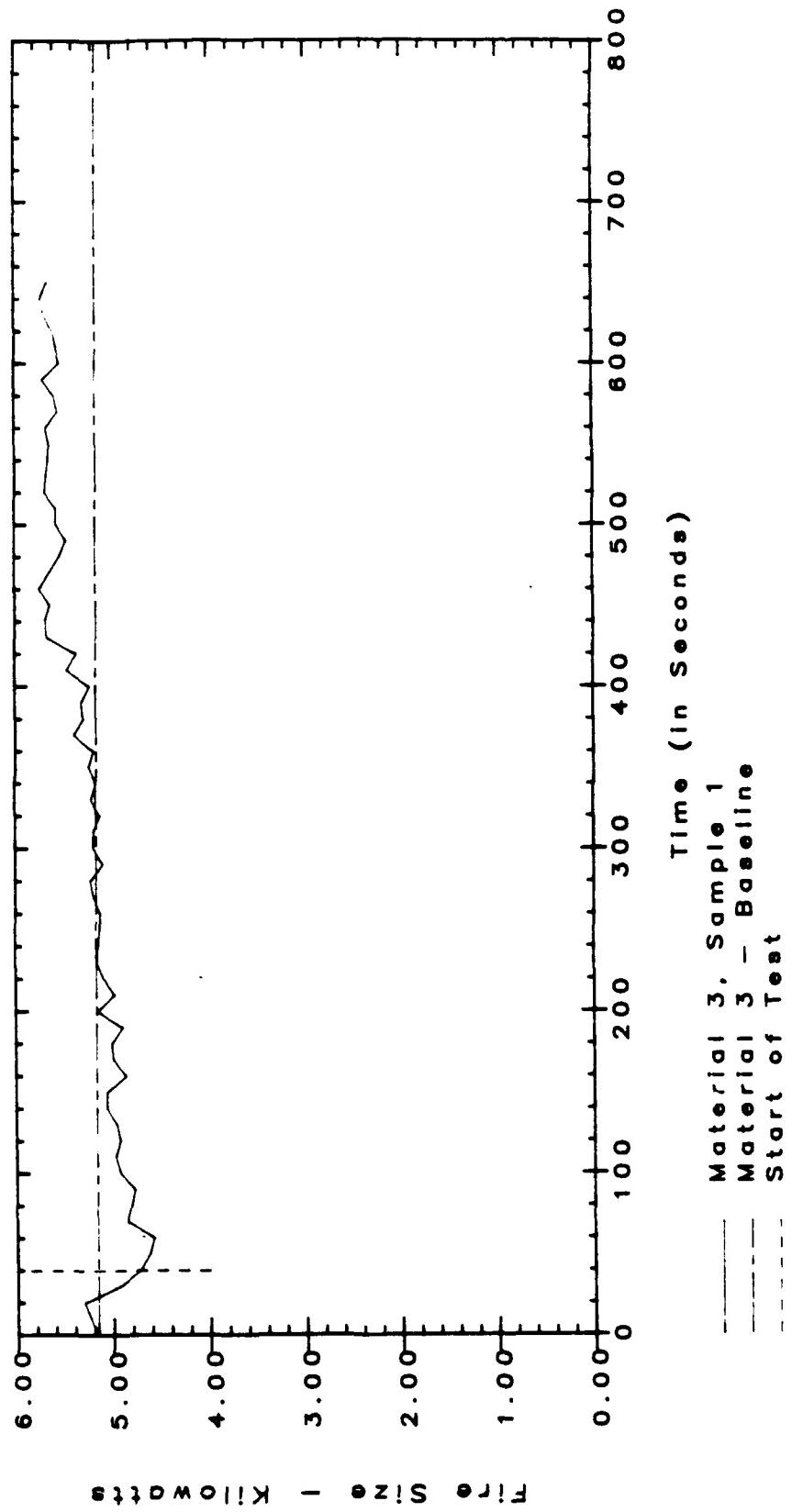
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
20	50	Spontaneous popping and blistering
40	100	Explosive delamination up to 200 mm
65	250	Bubbles; burnt on center line
90	400	38.10 mm bubbles formed then popped
110	300	Black char
140	0-250	Material starting to separate
200	400-700	Surface does not appear to be blistering; light smoke
240	0-300	Original backing peeling off
280		Thermal plastic slumping over an area of 200 mm in diameter; material is delaminating
360	0-425	Black char
	425-750	Original surface, no bubbling
	0-300	Material separating from backing and flaking
510		Flaking; section fell off backing

Sample Description at End of Test

600	0-300	Black char and flaking
	300-450	Black char
	450-750	Surface undamaged

IMO FLAME SPREAD TEST

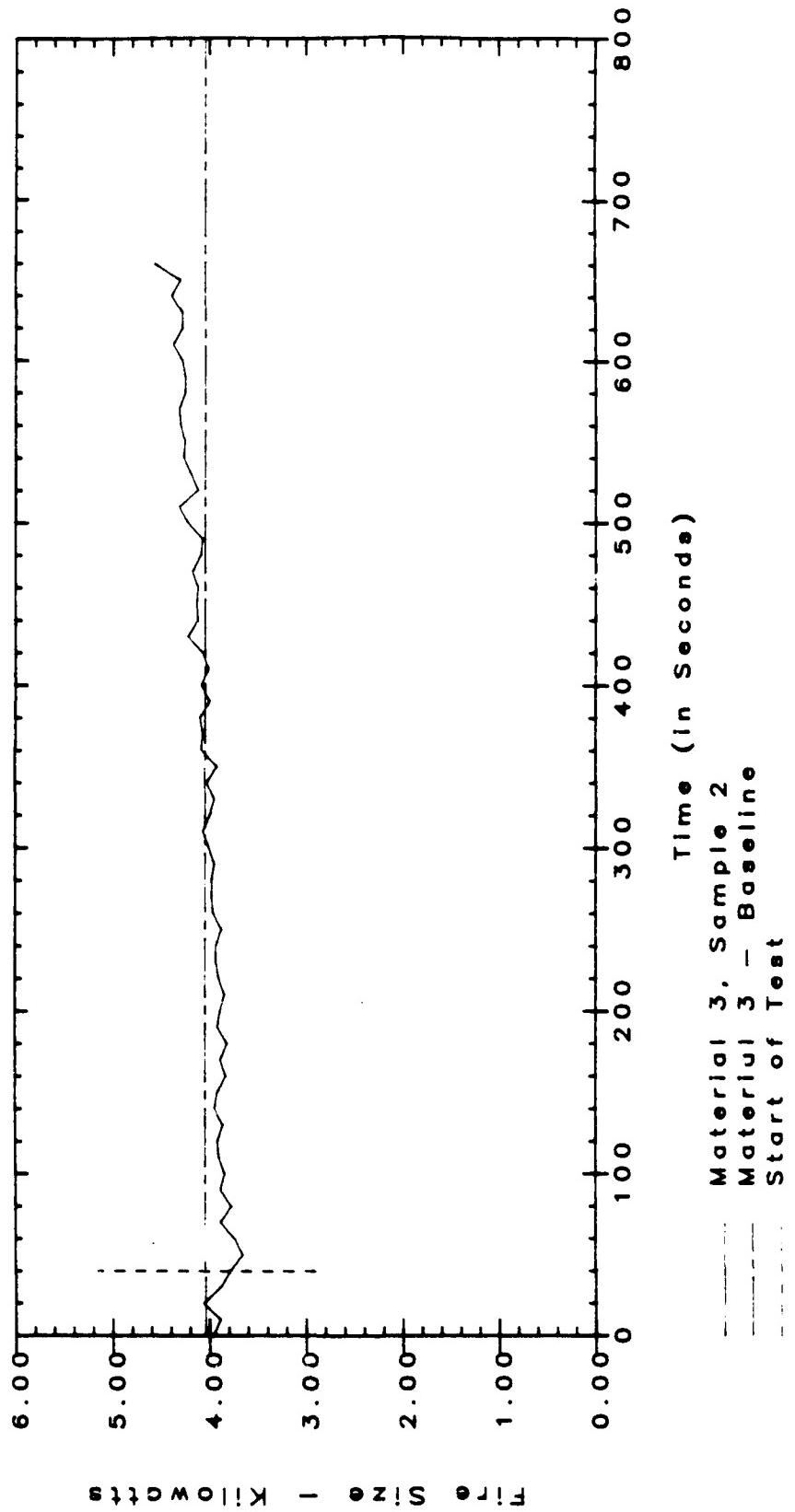


TEST: M3S2SP1 Specimen Number 2  
DATE: 10 November 1986  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10	40	Spontaneous bubbling and charring
30	100	Explosive delamination
35	150	Explosive delamination
55	200	Char on top of surface bubbles, very explosive delamination
65	200	Explosive delamination
70	200	Heavy smoke in area of explosive delamination
80	250-300	Loud pop above center line
85	250	Char line, heavy below center line; light above center line
110	50-100	Laminate has separated and alligated above the center line
130	350	Char line
145	350	Explosive delamination has ceased; surface bubbles on sample
160	200-250	Black char
170	250-350	Light brown char
180	50-100	Laminate has separated
210	200-300	Laminate separating below center line
230	375	Bubbles form
240	300	Complete alligatoring
240	350	Black char
300	300	Explosive delamination has ceased
320	0-250	Laminate has separated from backing and is flaking off
330	250-350	Complete black char
335	350-400	Light brown char
345	400	Surface bubbles have ceased; very little smoke progression
375	400	Material immediately above impinging flame turning white; other material is separating from backing
540	0-50	Turning white at impinging flame
555	50-250	Separating from backing with increased alligatoring across surface
570	250-350	Complete black char
575	350-475	Light brown char
600	425-440	Light bubbles

IMO FLAME SPREAD TEST



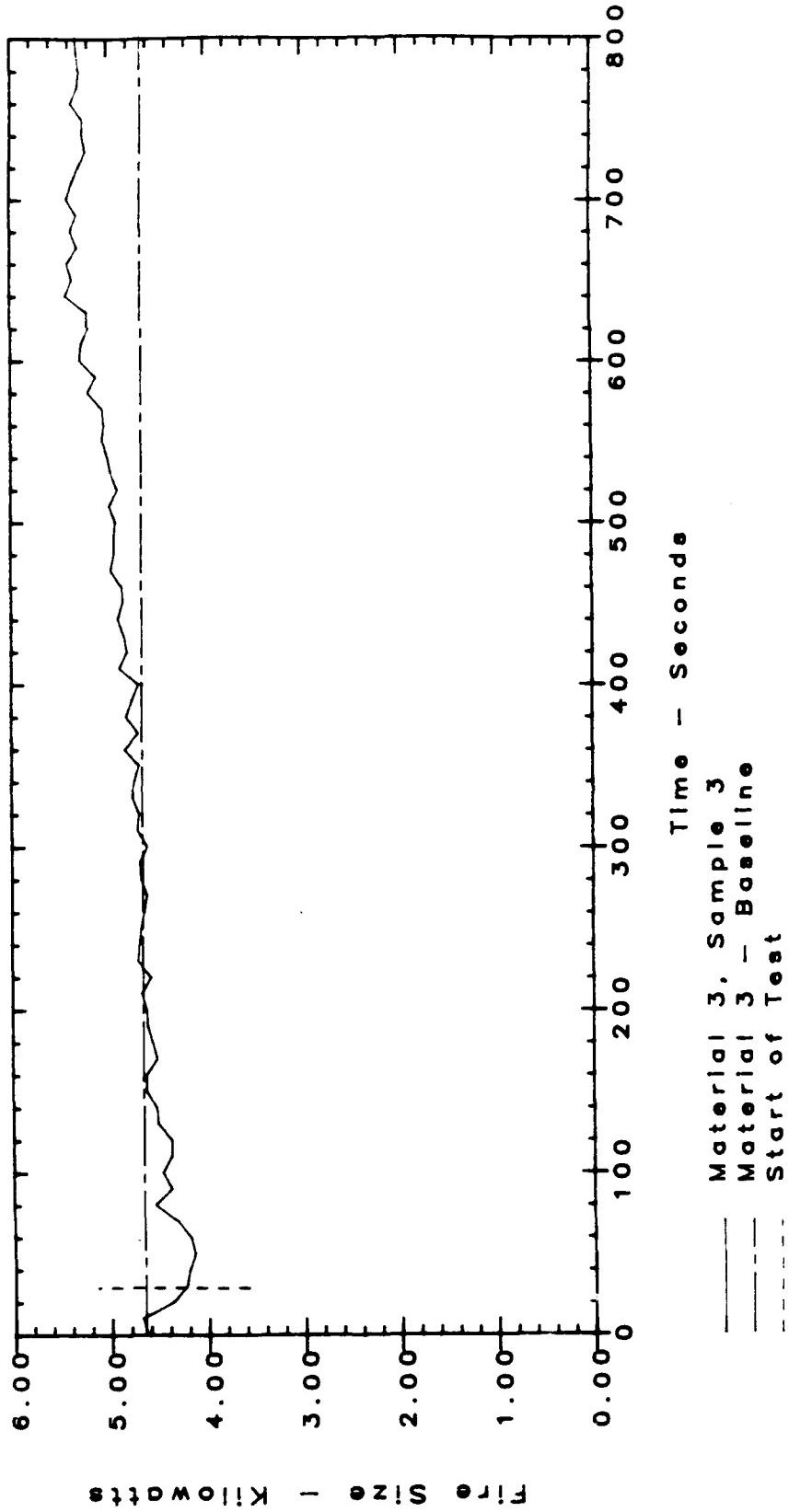
TEST: M3S3SP1 Specimen Number 3  
 DATE: 12 November 1986  
 Material: High Pressure Laminate

Time (sec)	Distance (mm)	Remarks
30	0-40	Flame flicker
35	0-150	Fire and spontaneous explosive delamination
45	150	Fire out
55	200	Turning brown; charring
60		Large bubble at beginning exploded, caught on fire; fire is out; heavy smoke in area
75	250	Explosive delamination
100		No flame; moderate smoke; dark char
110		Material starting to separate at site of explosion, 50.80 mm diameter
120	300	Brown char line; bubbles forming in front of char line; turning brown on top of bubbles
135		Heavy smoke at char line area
185	350	Char line; light smoke
330	0-400	Char line
335	0-350	Below center line, laminate material separating from backing
345	100-300	Above center line material separating
355	0-100	Exposed backing when large bubbles exploded; no smoke; no flame
510		All action appears to have ceased; no flame; no smoke
570	0-100	Flame on laminate material that exploded does not seem to be spreading
600		Not a heavy burn; flickering; piece fell off
630	150	Flames start to spread above center line on laminate material; very light flame, hardly visible
720	200	Pieces of laminate material fell off; flame increased; burning material that exploded shows very light smoke, small flame flickering
750		No flame spread on this material, just burnt residue from original explosion
830	200	Fire flickering; fire out

Sample Description at End of Test

860	0-200	Above center line, laminate material has turned white; rest of area laminate back has fallen off
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IMO FLAME SPREAD TEST



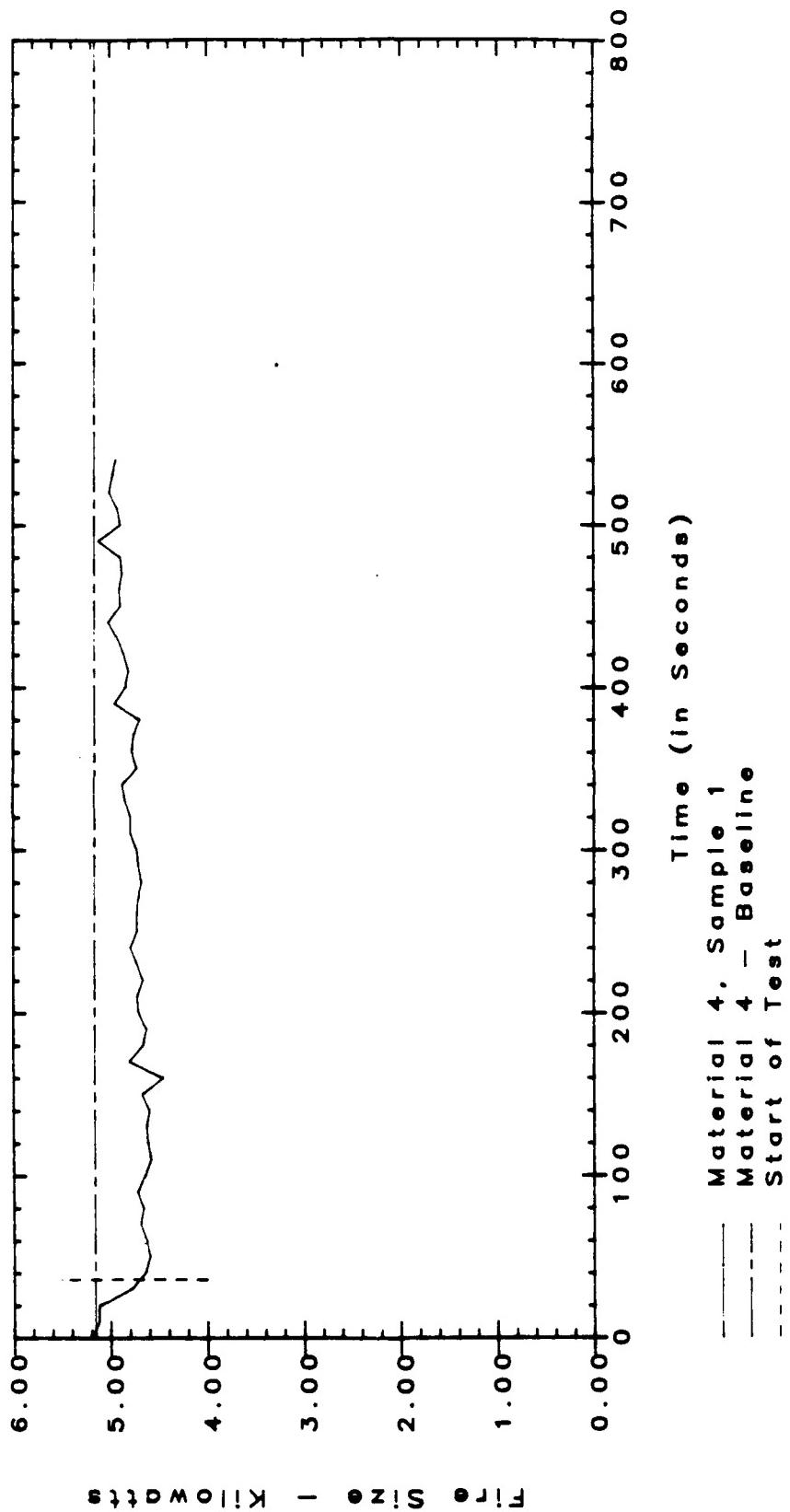
B-1.24

TEST: M4S1SP1 Specimen Number 1  
DATE: 7 November 1986  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
25	50-250 250	Spontaneous bubbling Slight char; bubbles, 1.58 mm diameter
35	300	Bubbles forming; no flame; no black char
60	0-200	Smoke appears; slight char
90	400	Bubbles decreasing to center line
100	0-250	Slight char; bubbles, 1.58 mm diameter
105	0-250	Slight char; bubbles, 1.58 mm diameter
290	350	Black char across surface
360	550	Bubbles; no fire

IMO FLAME SPREAD TEST



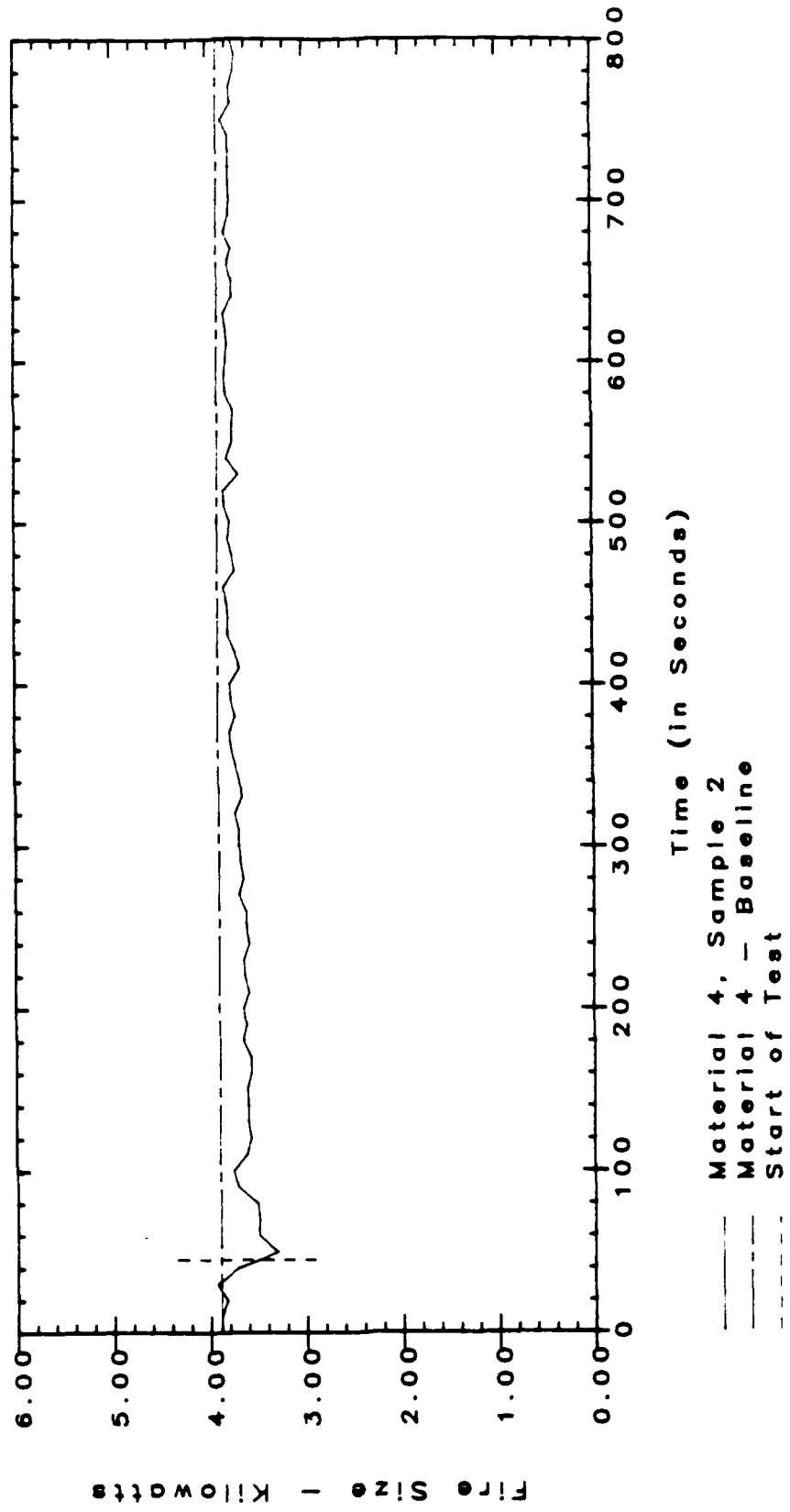
TEST: M4S2SP1 Specimen Number 1  
DATE: 10 November 1986  
Material: Coating

Time (sec)	Distance (mm)	Remarks
8		Light char at impinging flame; starting to smoke; no fire
15	200	Very small spontaneous bubbles
30	0-150	Light char above center line; no flame
40		Moderate smoke
45	300	Bubbles; no flame
60		Pilot flame area turning white; moderate light char on top of bubbles above center line
80	350	Surface bubbles
95		Smoke has increased
105	200	Char line on top of bubbles above center line
120	400	Bubbles, forward
140	0-200	Light gray char
150		Moderate smoke; no flame
160	0-25	Pilot flame area, white char
220	300	Complete black char line
230	500	Bubbles
235		Light smoke
285		No change on the sample surface
365	0-50	Impinging flame; white char
375	50-300	Complete black char across surface
385	300-350	Light brown char
390	350-500	Light bubbles on surface
400		No flame

Sample Description at End of Test

545	0-250	Light gray char
555	250-350	Dark brown char
560	350-400	Light brown char
570	400-550	Light surface bubbles
580		No flame on this test

IMO FLAME SPREAD TEST



B-1.28

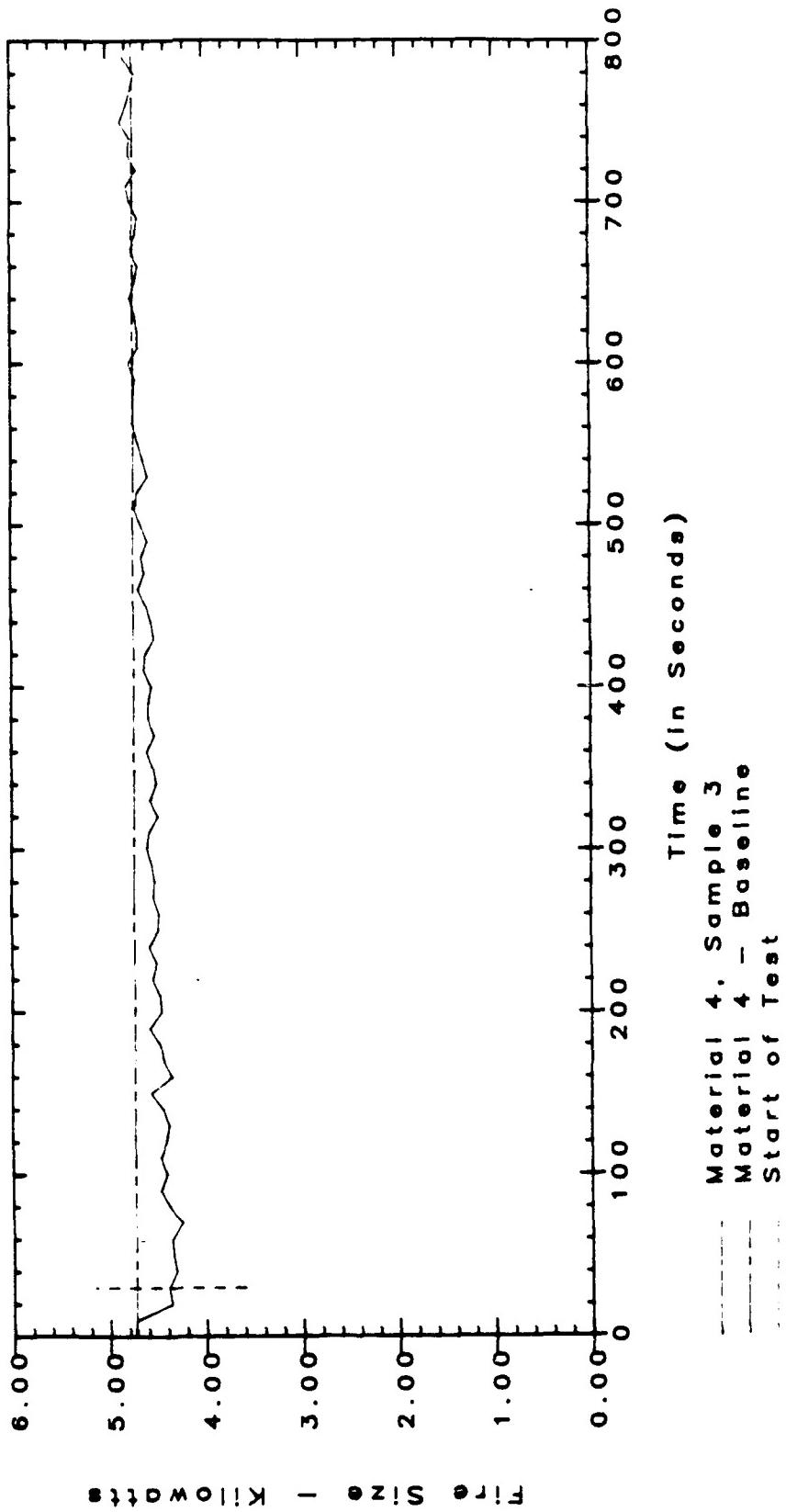
TEST: M4S3SP1 Specimen Number 1  
 DATE: 12 November 1986  
 Material: Coating

Time (sec)	Distance (mm)	Remarks
15	100	Spontaneous bubbles
17	150	Spontaneous bubbles
20	200	Spontaneous bubbles
23	250	Spontaneous bubbles
25	50-200	Smoke
35	300	Bubbles
40		No flame
45	0-200	Heavy black smoke
60	0-100	Bubbles are less than 1.58 mm diameter; top of bubbles turning brown
70	350	Bubbles on center line
75	150	Turning brown on top of bubbles
90	400	Bubbles on centerline
105	0-200	Light color char on top of bubbles
115	0-200	Complete char on surface
125		Moderate smoke; no flame
140	450	Bubbles on centerline
150	250	Complete light brown char line
180		Light smoke; no flame
225	0-150	Dark black char line
235	150-300	Light brown char line
240	300-500	Bubbles on center line surface
280	0-250	Dark char line
285	250-325	Light brown char line
290	325-575	Bubbles on surface; little smoke
300		Little smoke
340	0-150	Black char starting to turn white
470	0-250	Complete white char across surface
475	250-300	Dark brown char
480	300-375	Light brown char
490	375-550	Light bubbles on surface

Sample Description at End of Test

630	0-300	White char across surface; hairline crack
635	300-350	Dark char
640	350-425	Light brown char
650	425-550	Light bubbles on surface, 1.58 mm diameter

IMO FLAME SPREAD TEST

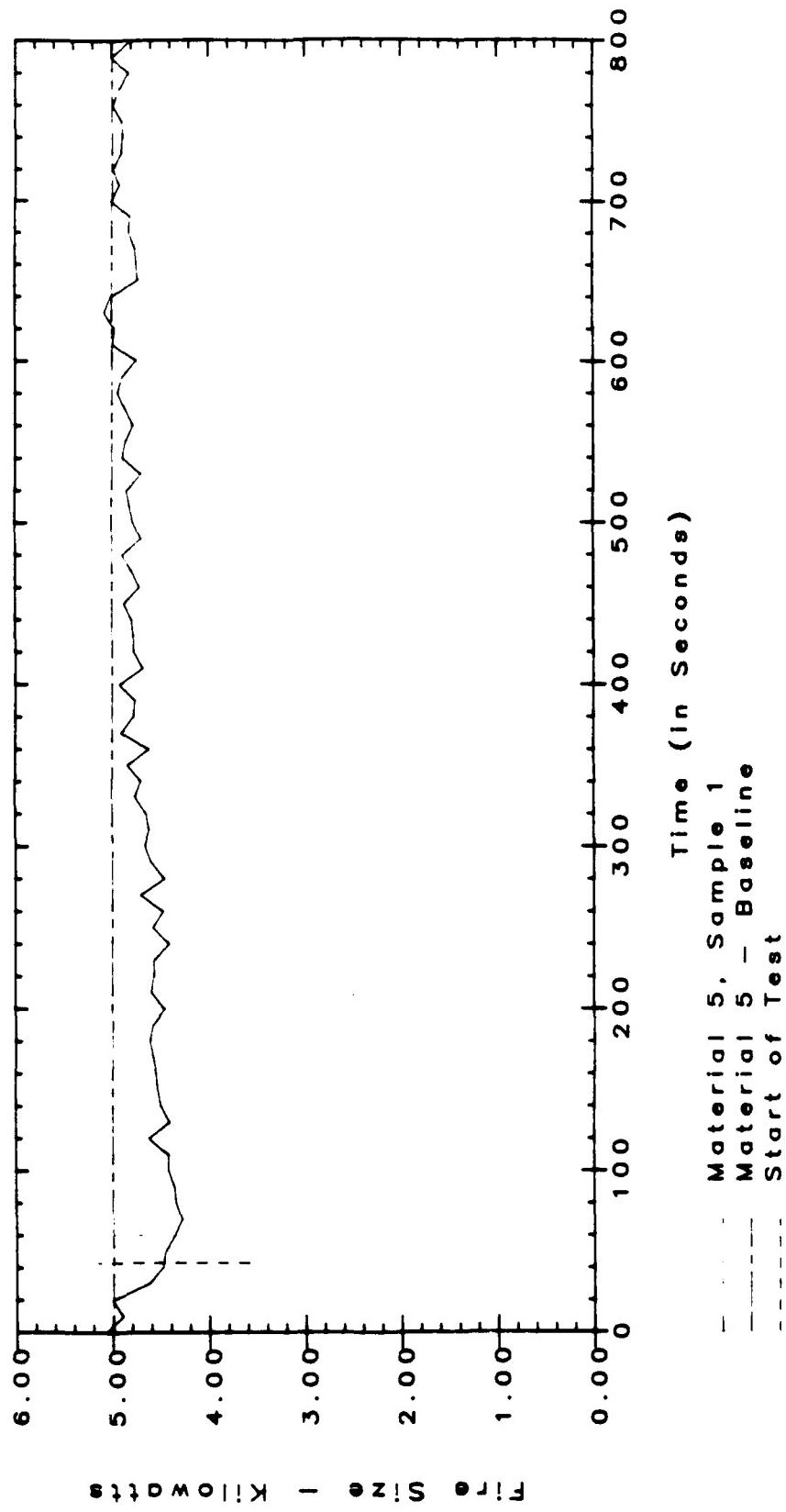


TEST: M5S1SP1 Specimen Number 1  
DATE: 7 November 1986  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
20	50	Slight bubbles up to 350 mm
55	0-150	Char; black-grayish in color
65	400	Slight bubbles; no flame
120	250	Black char; grayish in color
300		No flaming observed during test

IMO FLAME SPREAD TEST



TEST: M5S2SP1 Specimen Number 1  
 DATE: 10 November 1986  
 Material: Coating

Time (sec)	Distance (mm)	Remarks
10	0-250	Spontaneous bubbles
15	0-50	Surface flame at impinging pilot
20	300	Surface bubbles
30	0-150	Flashing surface flames for about 10 secs; then ceased
60	400	Bubbles
105	50	Dark char on center line; light brown surrounding it; heavy smoke
125		Orange flame around impinging pilot on center line; material turning white in a circle at impingement point
140	450	Surface bubbles
155	50-100	Circle has decreased in size; area surrounding has turned dark
170	200	Black, charring and alligatoring
180	500	Bubbles
190		Moderate smoke
220	200	Complete black char
230	200-250	Light brown char
240	250-500	Bubbles across the surface width impinging flame area; surface turning white at center line moving upward; no flame; moderate smoke
285	250	Solid black char line across sample
290	250-350	Light brown char
300	350-525	Bubbles on surface
350	300	Black char line
360	300-350	Light brown char line
365	0-50	White at impinging flame; Circle in that area is turning white, alligatoring, blistering, separating from backing
405	0-150	White char above center line
450		Moderate smoke
500	0-175	White char
510	175-350	Black char
525	350-400	Light brown char
535	400-600	Bubbles on surfaces, 3.18 mm - 1.58 mm diameter; 12.70 mm - 9.52 mm larger below center line
580		Smoke has decreased
645	0-250	White char
	250-350	Black char
	350-400	Light brown char
660	400-625	Bubbles; smoke has decreased

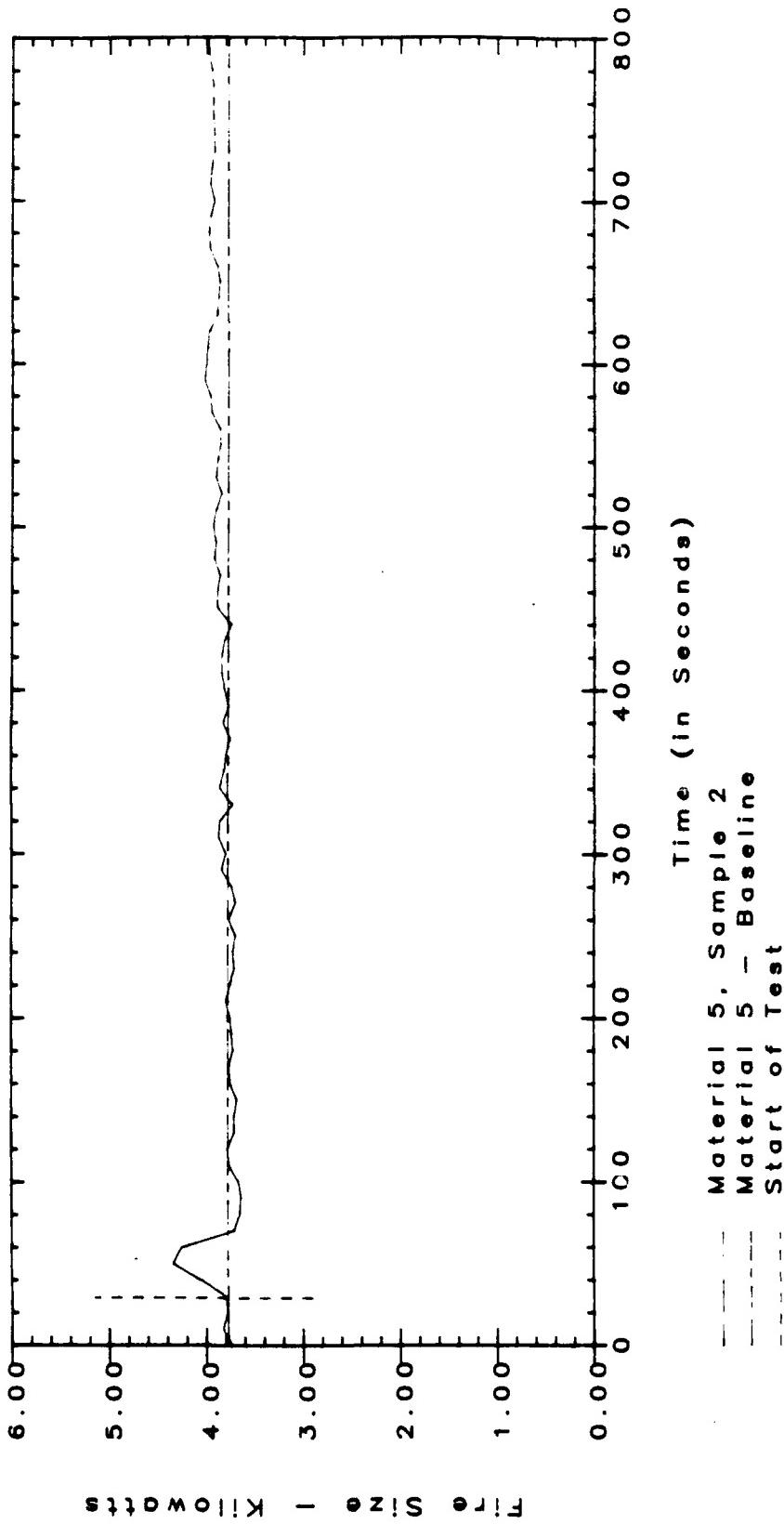
TEST: M5S2SP1 Specimen Number 1 (cont'd)  
DATE: 10 November 1986  
Material: Coating

Time (sec)	Distance (mm)	Remarks
690		No material has fallen from sample

Sample Description at End of Test

740	0-250	White char
745	250-350	Black char
750	350-400	Light brown char
760	400-625	Bubbles

IMO FLAME SPREAD TEST



B-1.35

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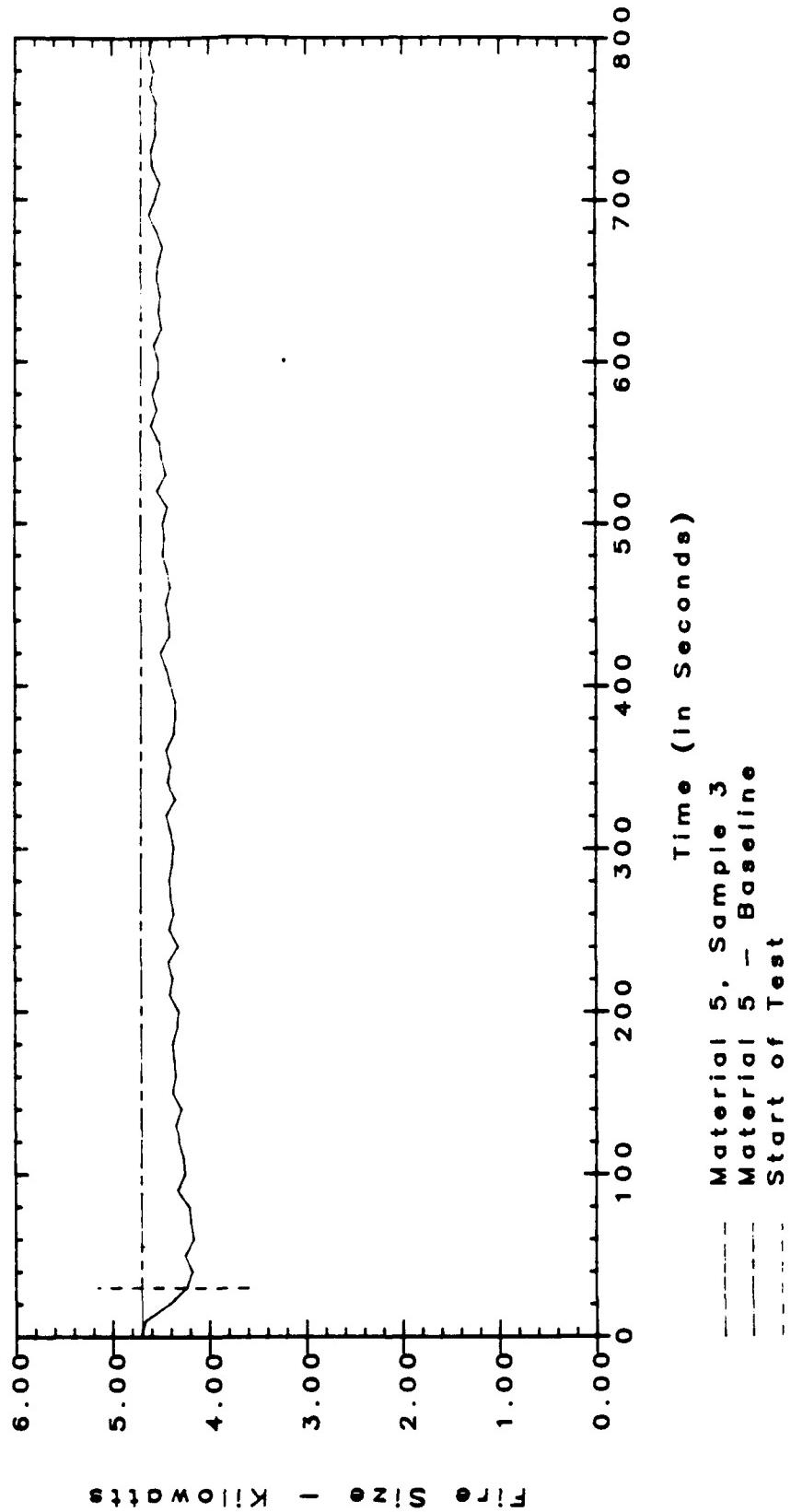
TEST: M5S3SP1 Specimen Number 1  
 DATE: 12 November 1986  
 Material: Coating

Time (sec)	Distance (mm)	Remarks
15	0-250	Spontaneous small bubbles
20	50	Light smoke
28	300	Bubbles 1.58 mm
40		Moderate smoke; no flame
50	350	Bubbles
55	0-200	Heavy smoke
75	0-100	Starting spontaneous char
80	150	Starting spontaneous char
83	200	Starting spontaneous char
95	250	No flame; heavy smoke; char, light in color
110	400	Bubbles on center line
145	0-250	Light brown char
155	250-300	Very little char
160	300-450	Bubbles across surface at center line
175		Heavy smoke in char area
190	0-200	Dark black char line
200	200-300	Light brown char line
205	300-475	Bubbles on surface; no flame; moderate smoke
210		Moderate smoke
365	0-25	Starting to turn white
372	25-300	Complete black char
380	300-350	Light brown char
385	350-550	Bubbles on surface; little smoke
425	0-100	White char has increased; no flame
580	0-200	White char completely across surface
585	200-350	Dark black char
590	350-400	Light brown char
595	400-550	Small bubbles, 1.58 mm diameter; little smoke

Sample Description at End of Test

725	0-250	White char completely across surface
735	250-375	Dark black char
740	375-426	Light brown char
750	425-575	Small bubbles on surface at center line

IMO FLAME SPREAD TEST

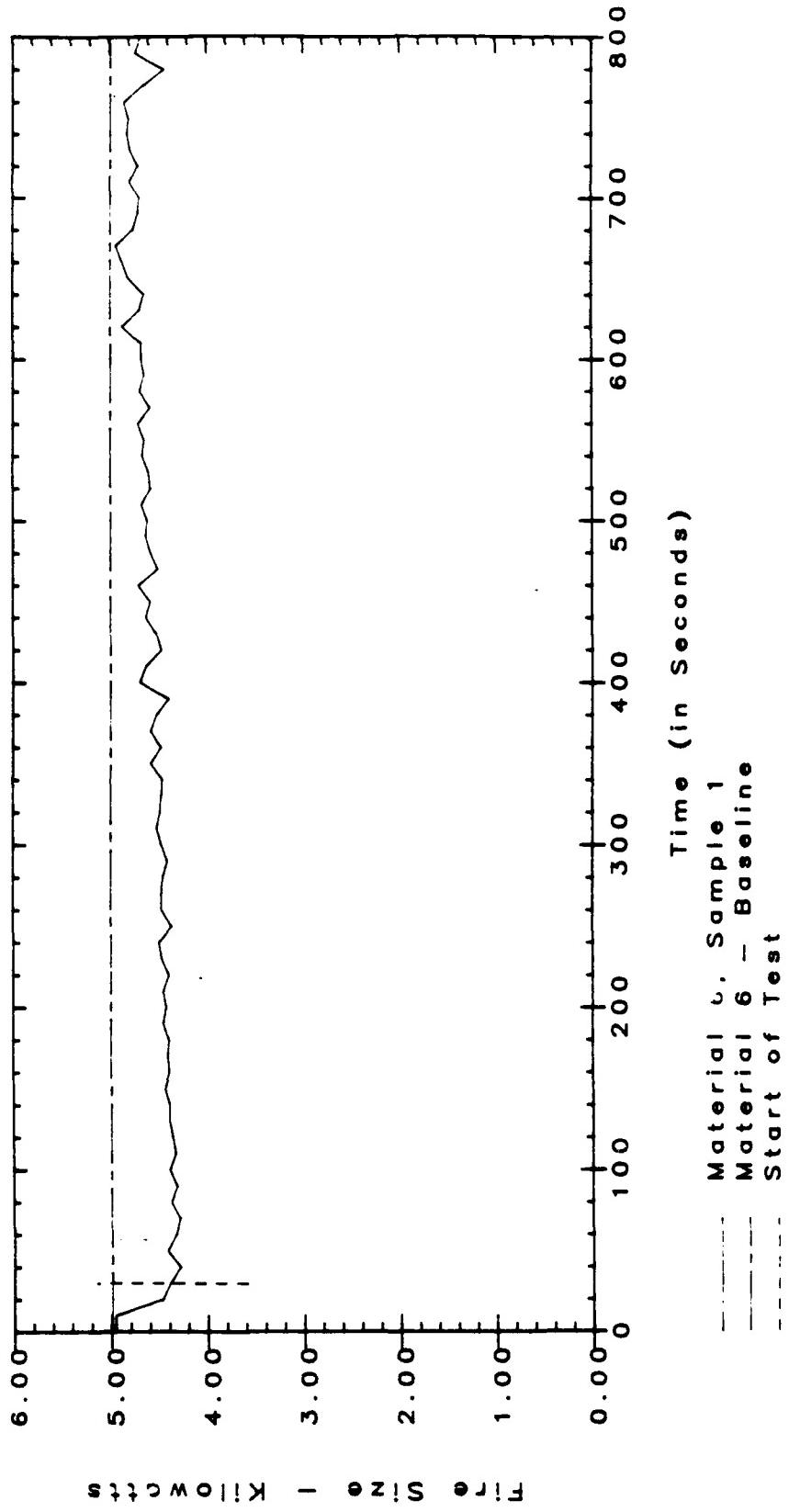


TEST: M6S1SP1 Specimen Number 1  
DATE: 7 November 1986  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
20	50	Bubbles to 250 mm; no flames
45	250	Spontaneous char; bubbles turn black
60	400	Bubbles
70	100	Constant black char increasing to 200 mm
115	450	Bubbles, 12.70 mm diameter
120	150	Constant black char
200	250	Complete char across surface of specimen
210	500	Forward bubbles; no flame
240	400	Black char on top of bubbles
300	550	Surface bubbles on center line
315	350	Complete black char; no flame

IMO FLAME SPREAD TEST

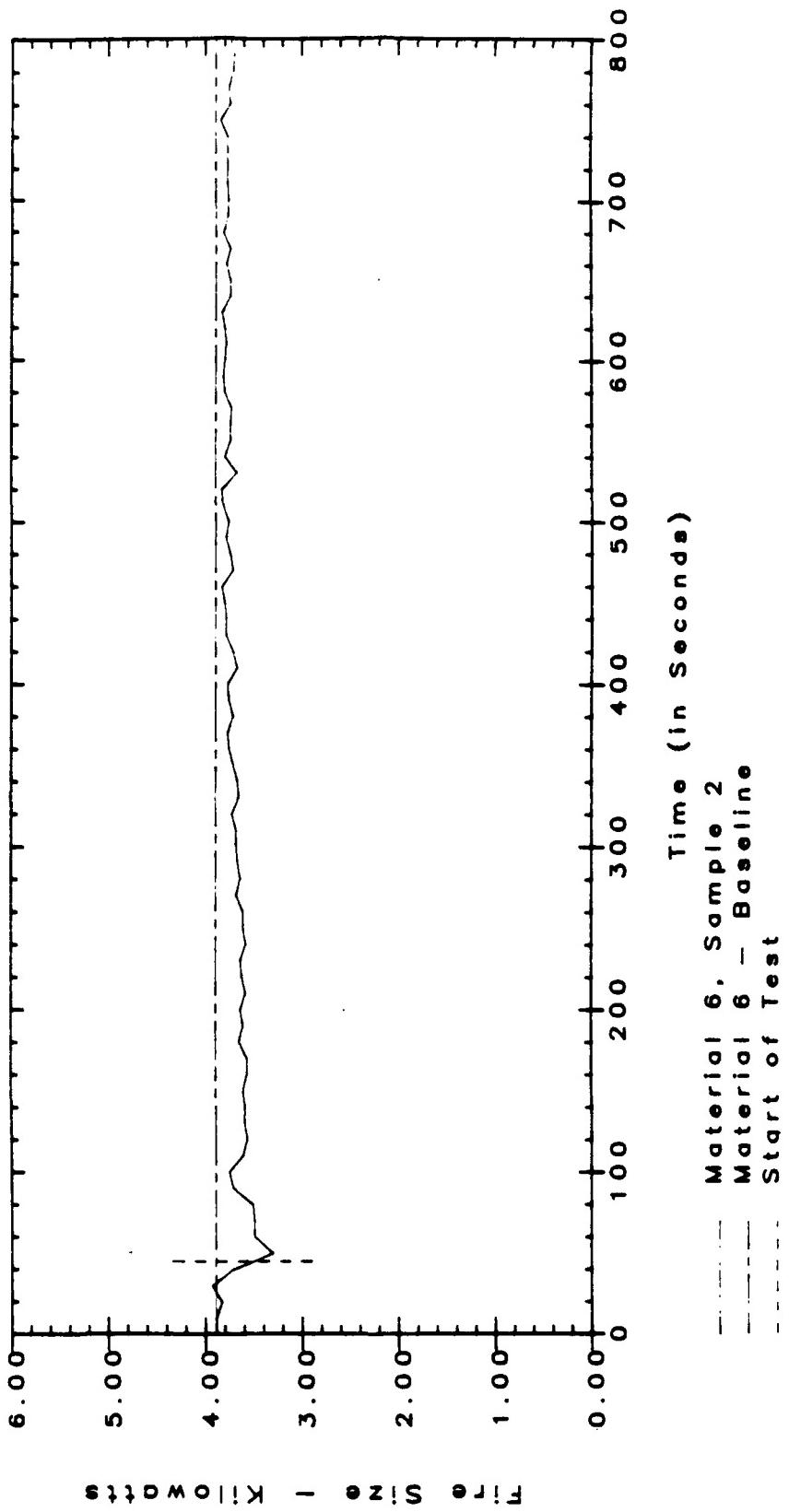


TEST: M6S2SP1 Specimen Number 1  
 DATE: 10 November 1986  
 MATERIAL: Coating

USCG- IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5	40	Immediate flame at impinging pilot
15	0-200	Spontaneous bubbling
25	50	Flame, top of bubbles turn black
30		Flame out
40	350	Bubbles with char, flame across top 100 mm of sample, off and on, no ignition
55		Flame out
60	300	Surface char on top of bubbles
75	0-300	Moderate smoke
110	450	Forward surface bubbles
125	0-200	Char
	200-350	Char on top of bubbles
	350-450	Raised bubbles on surface, 6.35 mm to 12.70 mm inch
165	300	Complete black char
200	500	Surface bubbles
210		Smoke decreases to minimum
220	300	Complete black char
230	300-400	Patches, black char
240	400-525	Surface bubbles
285	550	Surface bubbles
315	0-15	Impinging pilot flame, surface white
330	50-300	Complete black char
340	300-450	Patches, black char on surface bubbles
350	450-575	Surface bubbles, no flame, no smoke
460	0-100	White char
470	100-350	Black char
480	350-450	Black char on top of surface bubbles
485	450-600	Surface bubbles
525	50-150	White char, surface cracks, starting to separate from backing, light smoke
580	50-200	Cracks along center line, some white char
600	200-400	Complete black char
615	400-450	Patch of black char at top of surface bubbles
625	450-625	Surface bubbles, range 3.18, 6.35, 12.70, 19.05 mm
700	200-400	White char with surface cracks on center line, separating from original backing

IMO FLAME SPREAD TEST



B-1.42

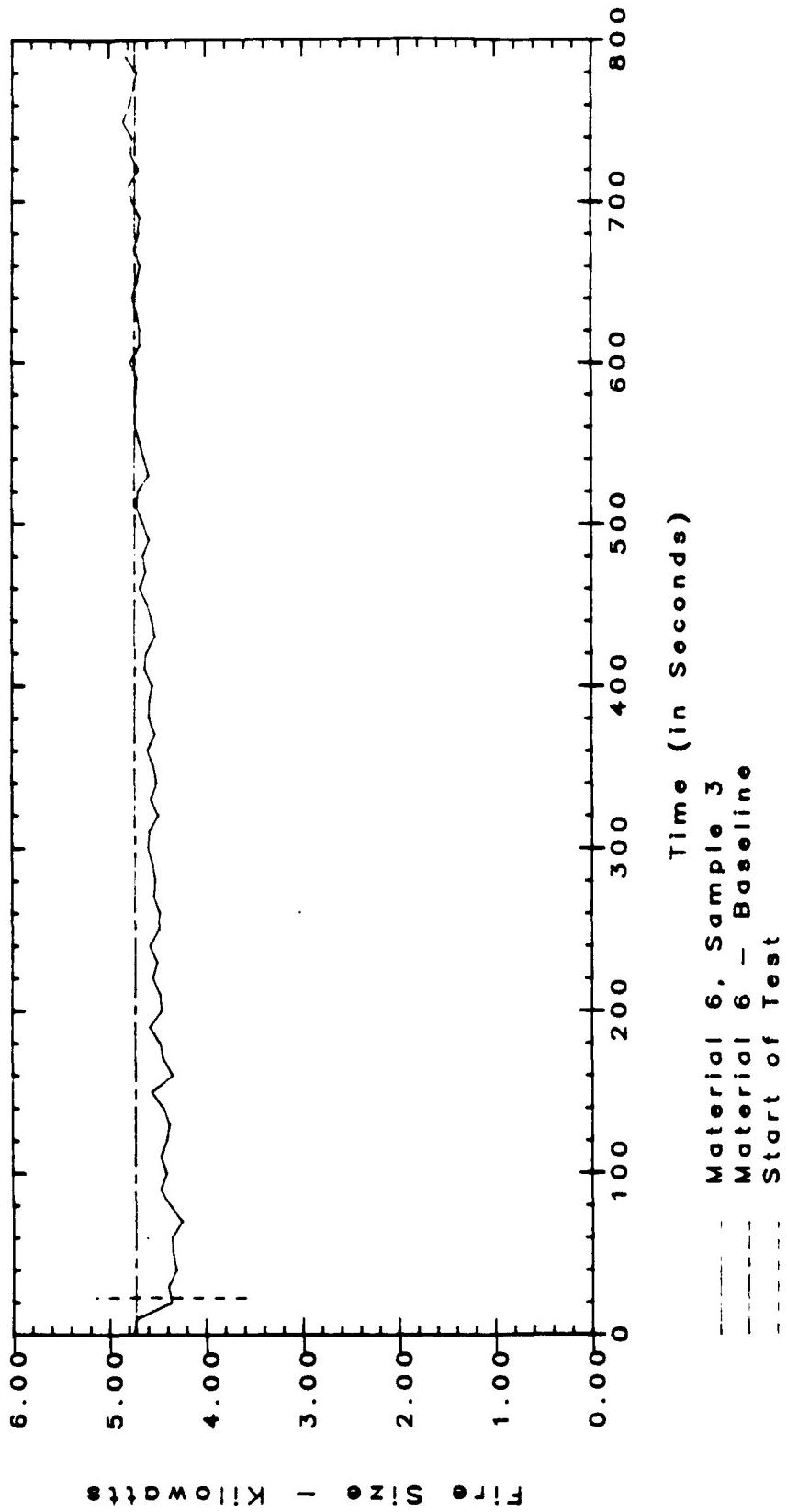
TEST: M6S3SP1 Specimen Number 1  
 DATE: 12 November 1986  
 MATERIAL: Coating

Time (sec)	Distance (mm)	Remarks
10	0-200	Spontaneous bubbles
15	250	Starting to smoke
20	50	Char on top of bubbles
23	100	Char on top of bubbles
25	300	Bubbles on center line
28	200	Char on top of bubbles; smoke; no flame
38	350	Bubbles on center line
45	250	Char on top of bubbles; no flame
63	400	Bubbles on center line, 6.35 mm - 12.70 mm diameter
92	450	Bubbles on center line
100	0-100	Char on top of bubbles has covered sample surface
105	300	Char line
120		Little smoke; no flame
160	500	Bubbles on center line
180	0-300	Complete black char across sample surface
185	300-400	Light char on top of bubbles
195	400-525	Bubbles on center line; no flame; little smoke
205		Little smoke
310	0-300	Solid black char across surface
318	300-400	Char on top of bubbles
325	400-575	Bubbles on center line 6.35 - 12.70 mm diameter
330		Very little smoke; no flame
450	0-100	Dark char starting to turn white
460	100-350	Dark brown char across surface
465	350-450	Bubbles turning brown with char
475	450-625	Bubbles on center line; little smoke; no flame
480		No flame

#### Sample Description at End of Test

710	0-225	Surface is white with char; hairline cracks
720	225-425	Black char
725	425-575	Black char on top of bubbles
740	575-650	Last bubbles on center line

IMO FLAME SPREAD TEST



TEST: M7S1SP1 Specimen Number 1  
DATE: 7 November 1986  
MATERIAL: Coating

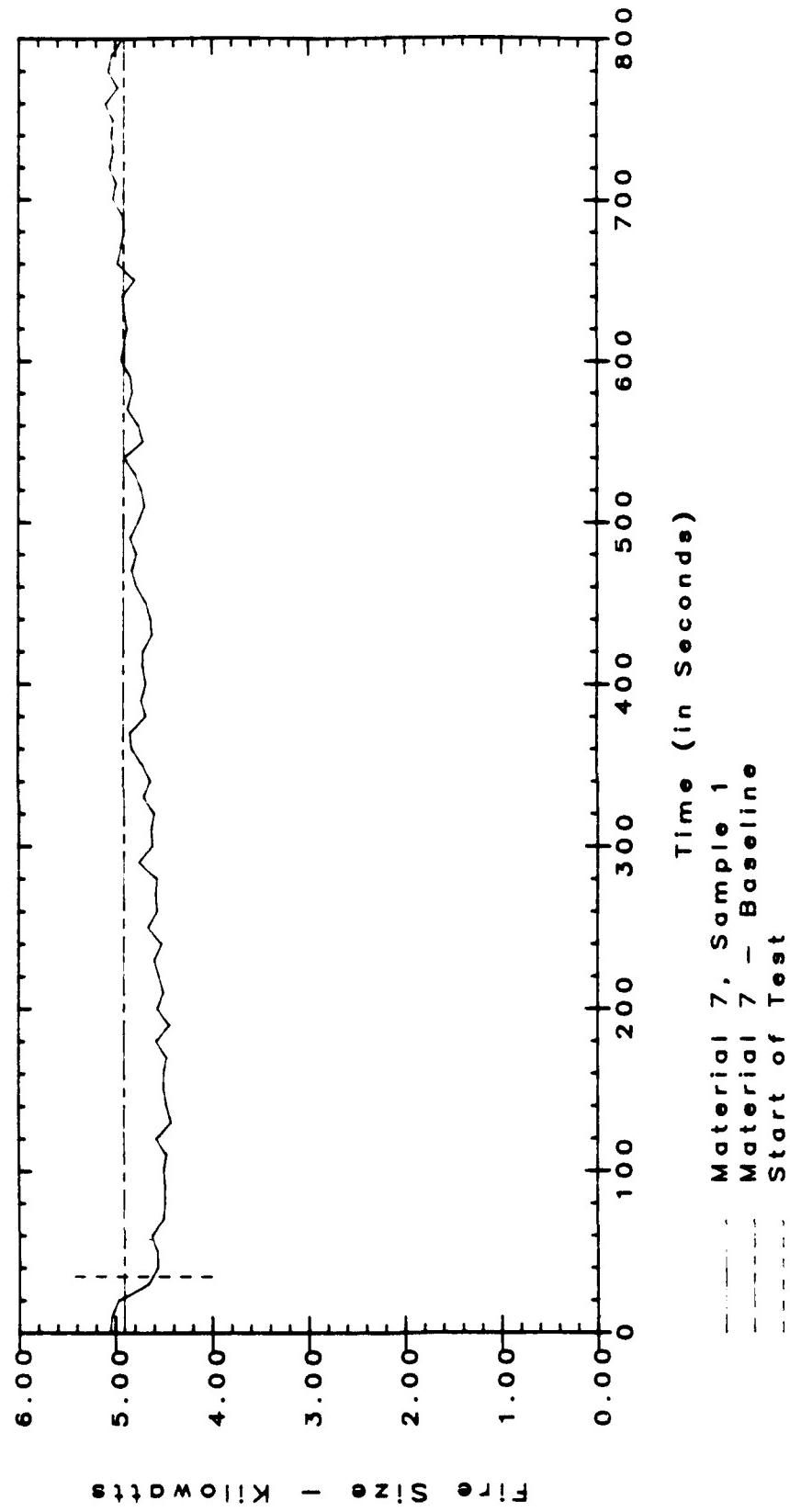
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
30	300	Spontaneous charring; light in color
55	350	Complete charring across sample
90	500	Bubbles
120	400	Charring; still no flame
160	150	Dark black char
210	450	Dark char
300	0-450	Light brown char
400	450-550	Slight bubbles on surface; material not disfigured; no burning; honeycomb surface
480		No disfiguring of material; light color char on surface
525	500	Black char
540		Slight bubbles up to 600 mm
560	0-100	Material starting to turn white; still not disfigured
600	600	6.35 mm bubbles on center line
	650	6.35 mm bubbles above center line

Sample Description at End of Test

700	0-200	Surface has turned white
	200-525	Light
	525-600	Bubbles
	650	Bubbles at center line
800		No fire on this test

IMO FLAME SPREAD TEST

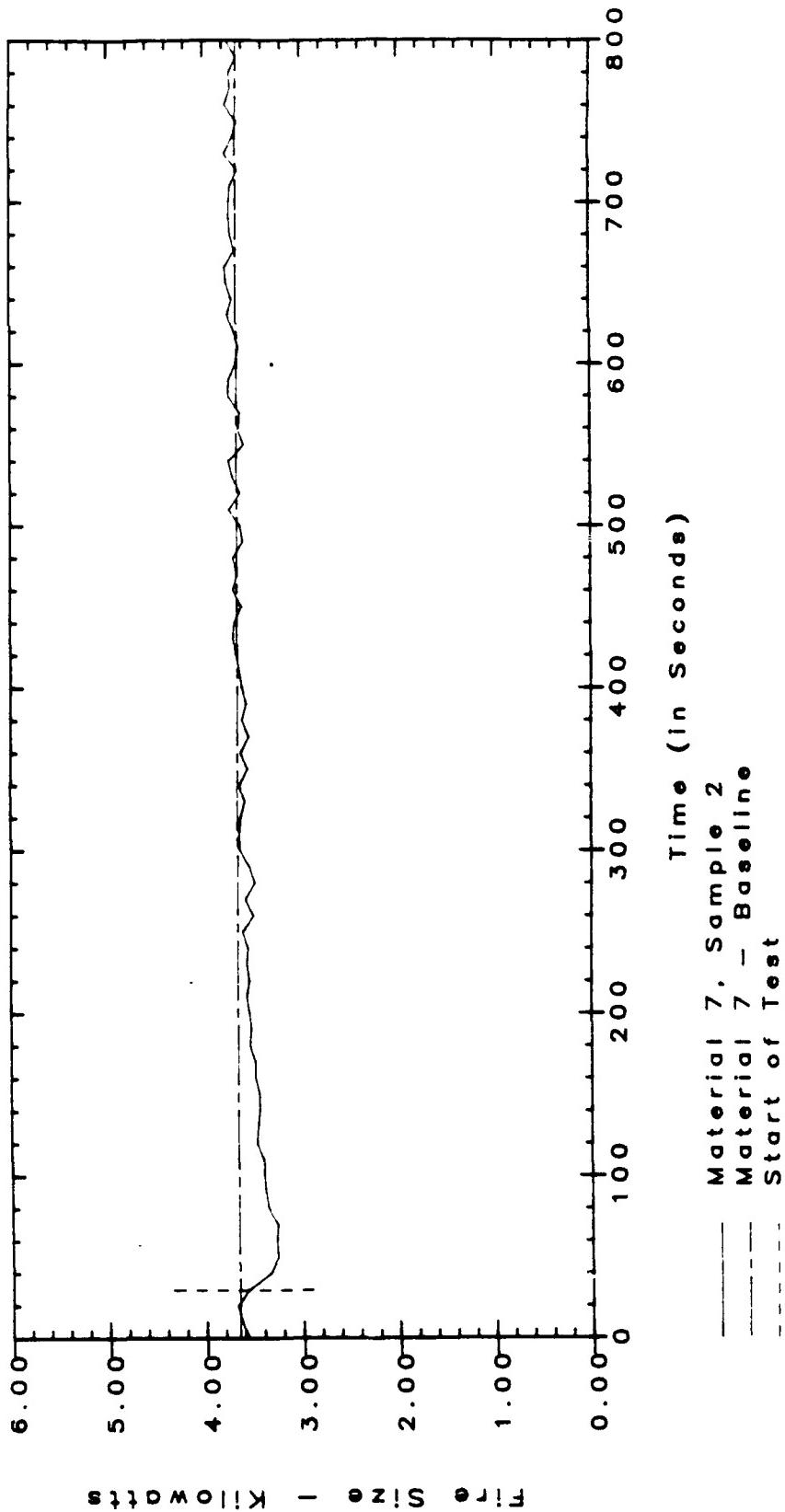


TEST: M7S2SP1 Specimen Number 1  
 DATE: 10 November 1986  
 MATERIAL: Coating

<u>Time</u> <u>(sec)</u>	<u>Distance</u> <u>(mm)</u>	<u>Remarks</u>
15	200	Spontaneous charring
30	300	No flame at the width of impinging flame; there is a light orange color, glowing; material is heating; looks undamaged except for char; fiberglass netting does not change through this test
55	350	Moderate smoke
50		No flame
85	10	Glowing the width of pilot flame
100	400	Char line
120	450	Surface bubbles; no flame
145	500	Surface bubbles
155	550	Surface bubbles above and below center line
165	450	Light char and smoke
360	0-25	White flame around pilot flame that has melted through fiberglass netting; material undamaged
370	25-500	Dark brown char
375	500-600	Light surface bubbles; material not burning
530	0-150	White char
540	150-500	Dark brown char
550	500-600	Bubbles on surface; material undamaged except by the impinging flame
640	700	Small bubbles forming below center line
655	550	Char line on center line

<u>Sample Description at End of Test</u>		
710	0-250	White char
720	250-550	Brown char
725	550-650	Bubbles at center line
730	650-750	Bubbles below center; material did not burn; undamaged except at the impinging flame where it melted through fiberglass backing

IMO FLAME SPREAD TEST



B-1.48

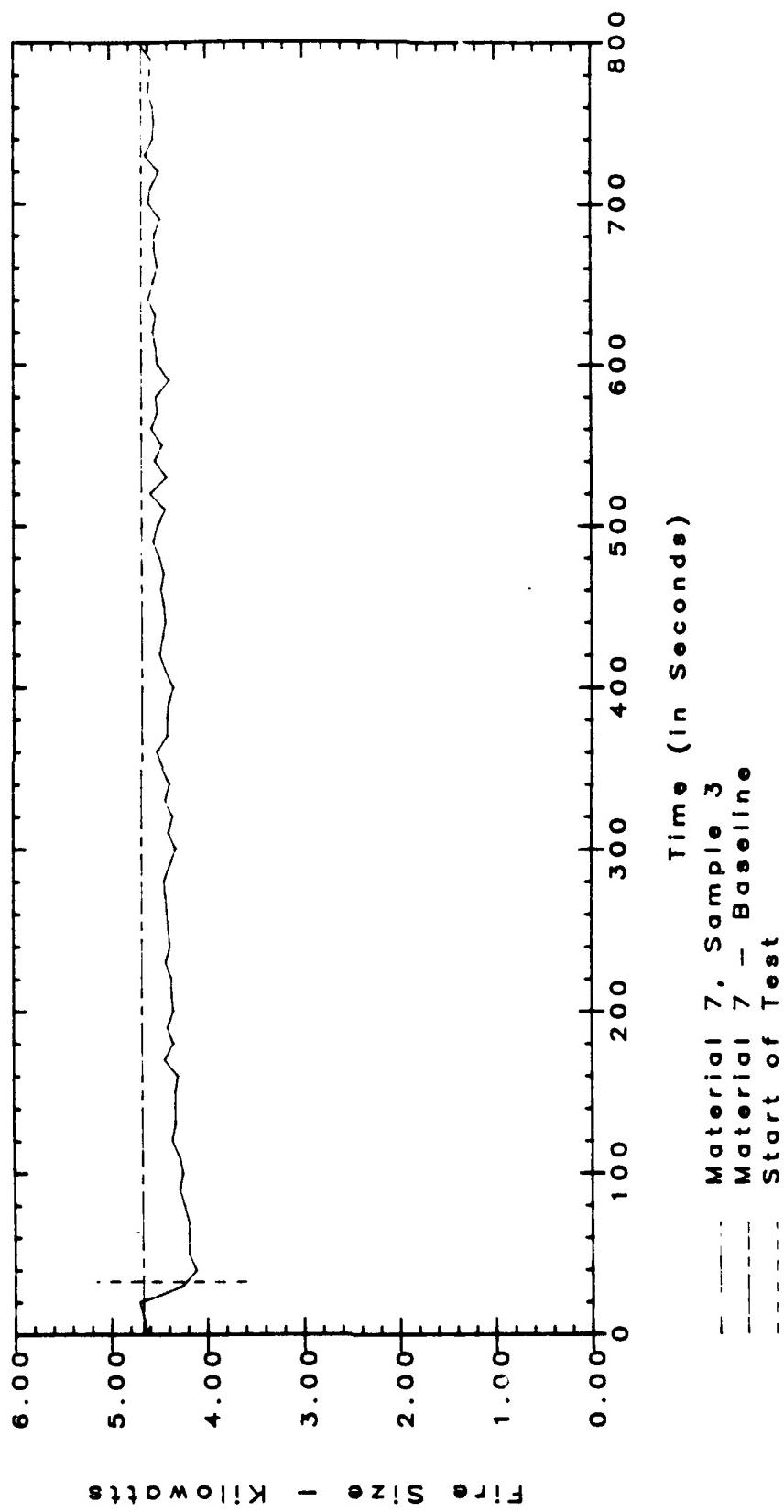
TEST: M7S3SP1 Specimen Number 1  
 DATE: 12 November 1986  
 MATERIAL: Coating

Time (sec)	Distance (mm)	Remarks
10	0-250	Spontaneous smoking and charring
17	200	Complete charring across surface
30	300	Complete charring across surface
40		Moderate smoke; no flame
90	400	Complete light brown char
125	450	Large bubbles forming on center line, 25.40 mm diameter
150		Top of bubbles turn brown with char
160		Light smoke; no flame
240	550	Raised surface bubbles; no flame; little smoke
260	400	Complete char line
270	450	Char line on top of raised bubbles
360	0-500	Light brown char across surface
370	500-560	Light gray surface, with bubbles about 12.70 mm diameter; little smoke; no flame; material is undamaged
495	0-100	White char
510	500	Char line
570	0-150	White char line
685	200	White char line

Sample Description at End of Test

755	0-250	White char line
770	250-500	Black char
780	550	Light color char on top of raised bubbles
790	550-650	Raised bubbles; no smoke; no flame

IMO FLAME SPREAD TEST



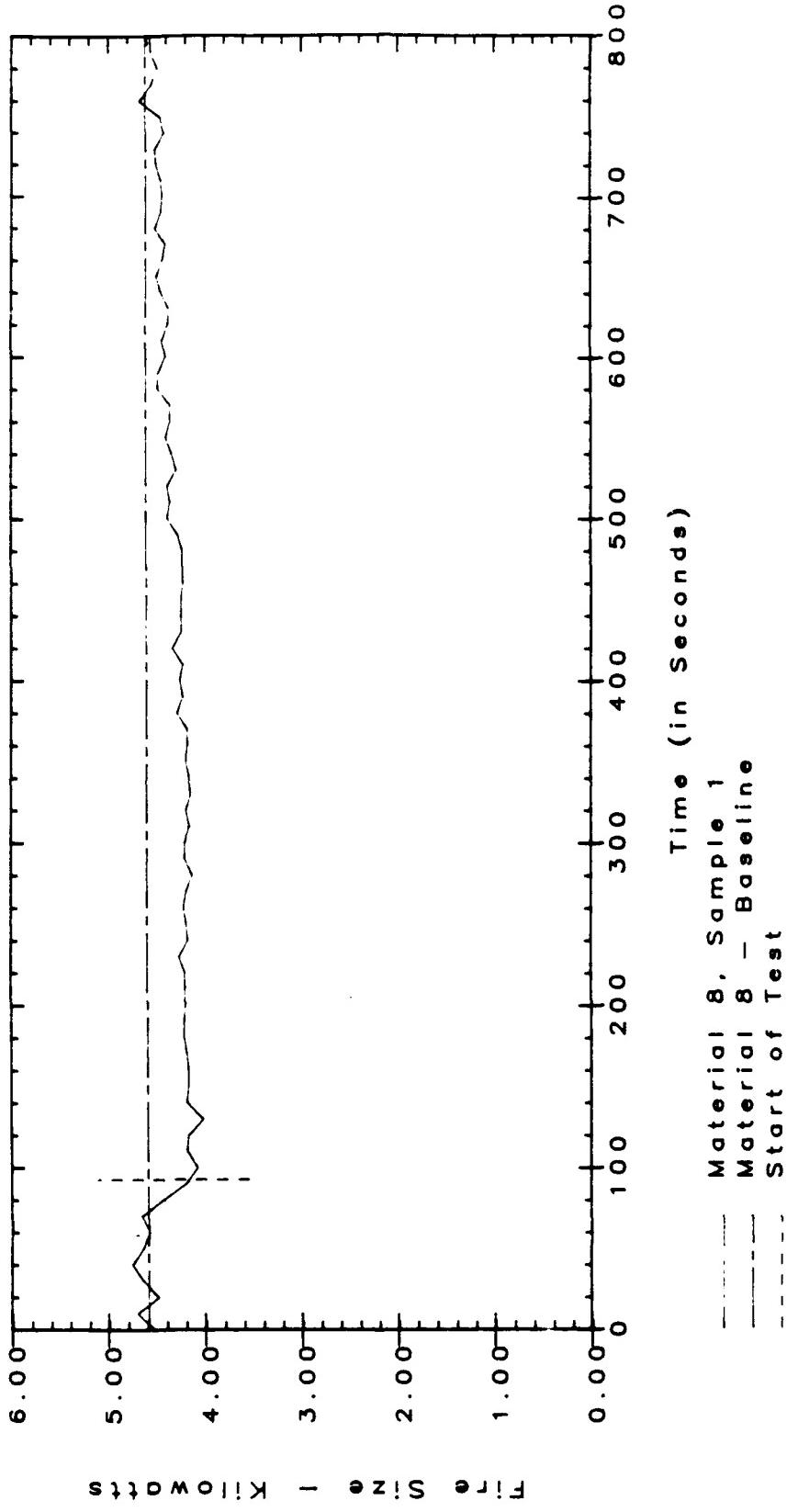
TEST: M8S1SP1 Specimen Number 1  
 DATE: 6 November 1986  
 MATERIAL: Wall Covering

<u>Time</u> <u>(sec)</u>	<u>Distance</u> <u>(mm)</u>	<u>Remarks</u>
30	200	Smoke and smoldering; no ignition
60	400	No flame; material bubbling
60		Material bubbling; no flame
110	450	Bubbles; no flame
135		Alligatoring on surface 200 mm; breaking up
180		Dark color of sample makes it difficult to read exact location of char; no flame
360		Blistering at 400 mm; didn't pop; 25.40 cm diameter
445	650	Slight blistering above and below
480	0-400	White and flaky; blistering and bubbles
600	600-625	Quick blistering at center line
660	250-350	Loose char, 50mm diameter
	0-100	White
	0-200	White starting to flake off
720	650	Small bubbles above center line
900		Bubbles continue to be seen 650 mm above and at center line
1020		Material has not progressed past 650 mm with bubble at center line
1080		350 mm area black charred piece only in area that has smoke

Sample Description at End of Test

1200	0-300	White char; residual flaking off back
	300-500	Black char separating from back
	500-750	Original backing with final blister at 625 mm

IMO FLAME SPREAD TEST



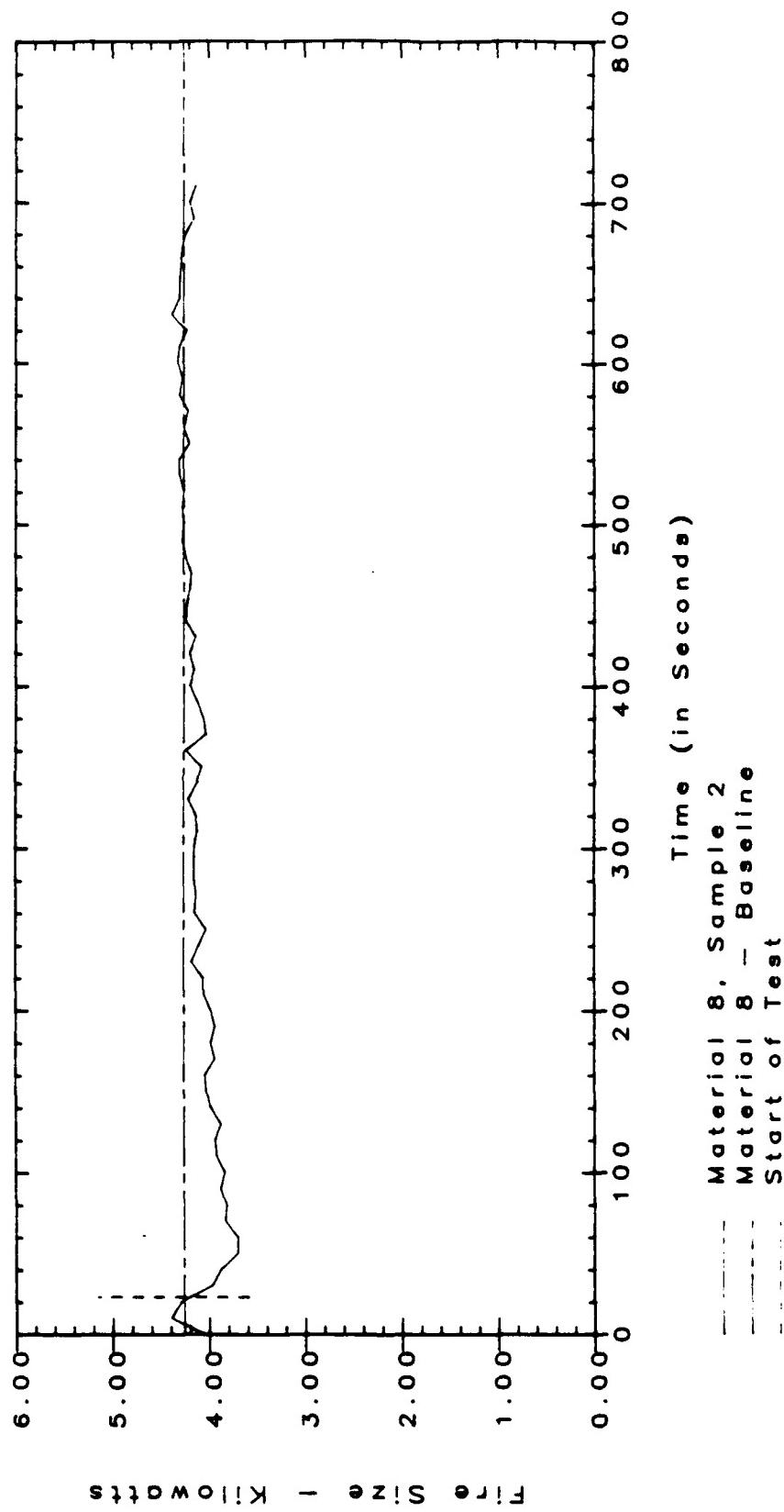
TEST: M8S2SP1 Specimen Number 1  
 DATE: 10 November 1986  
 Material: Wall Covering

<u>Time</u> <u>(sec)</u>	<u>Distance</u> <u>(mm)</u>	<u>Remarks</u>
10	0-300	Spontaneous bubbling
15	0-50	Surface flame at impinging pilot
25	350	Bubbles
30	350	Surface completely covered with bubbles
40	0-50	Intermittent surface flame, no ignition
50	0-350	Heavy smoke
60		Flames ceased
70	400	Bubbles
80	250	Heavy dark char
95	0-200	Alligatoring; no flame
105	450	Bubbles
135	500	Bubbles 6.35 mm off material, 6.35 mm - 12.70 mm diameter
160	300	Dark char and alligatoring; no flame
250	250-300	Material starting to separate from backing
270		Moderate smoke
280	550	Large bubbles starting to form
330	550	Large bubble has formed, 12.70 mm - 76.20 mm size
410	250-350	Material starting to separate from backing
415	600	Surface bubbles on center line; no flame
420		Moderate smoke

Sample Description at End of Test

570	0-200	White and alligatoring
585	200-300	Vinyl has separated from backing
620	300-650	Surface bubbles

IMO FLAME SPREAD TEST



B-1.54

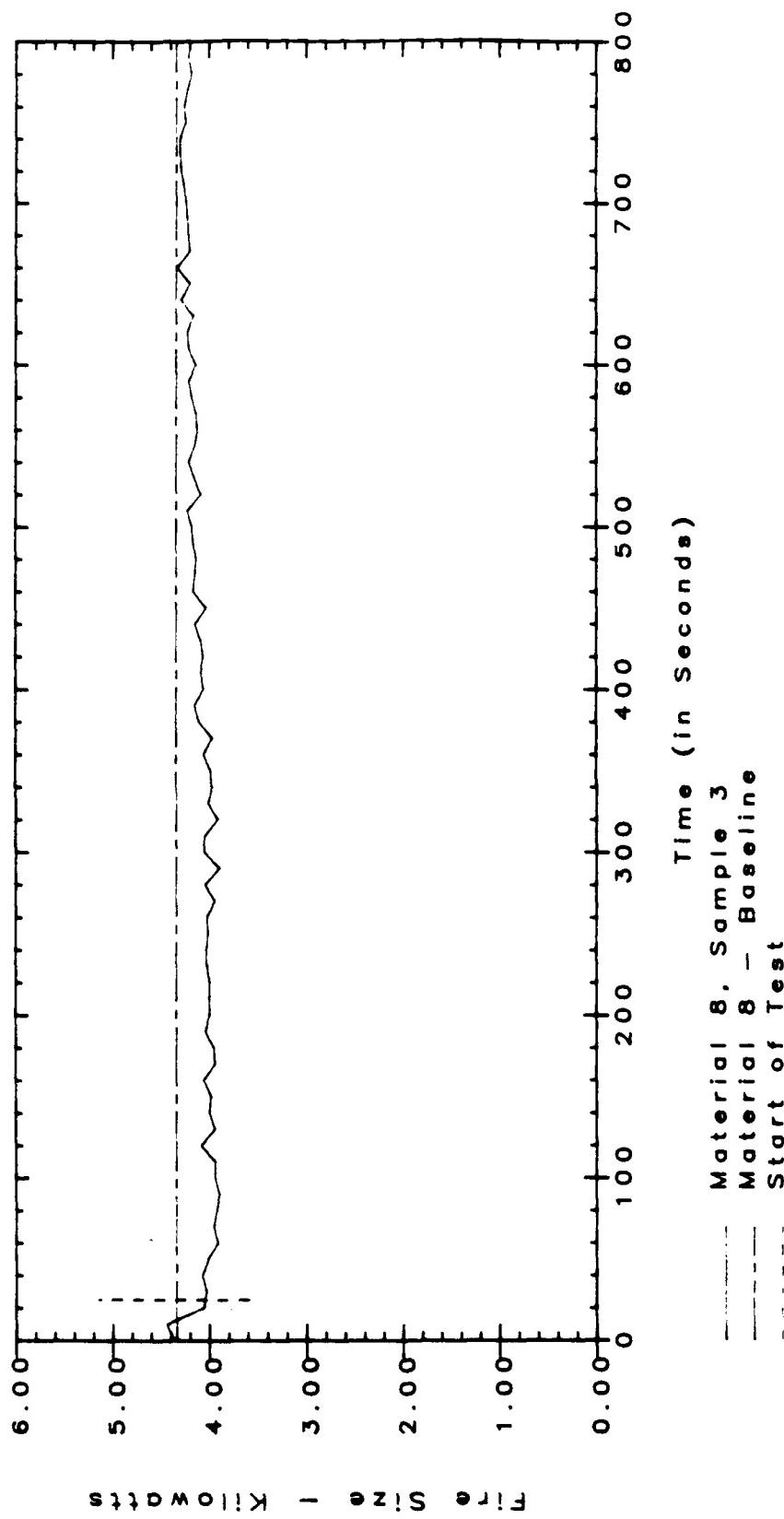
TEST: M8S3SP1 Specimen Number 1  
 DATE: 12 November 1986  
 Material: Wall Covering

Time (sec)	Distance (mm)	Remarks
15	0-250	Spontaneous bubbles
20		Moderate smoke, bubbles 2.540 mm - 3.18 mm diameter
30	350	Bubbles on center line
55	0-100	Black char line; heavy smoke
80	400	Bubbles on center line
90	200	Black char line
100	450	Bubbles; heavy smoke; no flame
120	0-100	Alligatoring
150		Bubbles increase to 6.35 mm diameter
155	0-200	Alligatoring
175	500	Bubbles
185		Moderate smoke
220	400	Char line
230		Bubbles, 6.35 mm diameter - 19.05 mm long
250		No flame
265	500	Large bubble forming, 25.40 mm diameter
295		Bubble has deflated
355	575	Bubbles on center line
365	425	Char line
375		Medium smoke; no flame
390	300-350	Material starting to separate at bottom
405	0-100	Turning white
455	300-350	Material starting to separate at top
460	150	White char line
475	600	Bubbles on center line
490	0-200	Small pieces on white char starting to flake off; fine ash
520		Moderate smoke
580	0-200	Vinyl has completely flaked off original backing
600	200-350	Dark brown char line
610	300-350	Material separated at top and bottom
615	400-450	Light char line
630	450-600	Bubbles on center line
635		Light smoke
720		Smoke has ceased

Sample Description at End of Test

740 0-250 White char material completely flaked off from original backing

IMO FLAME SPREAD TEST



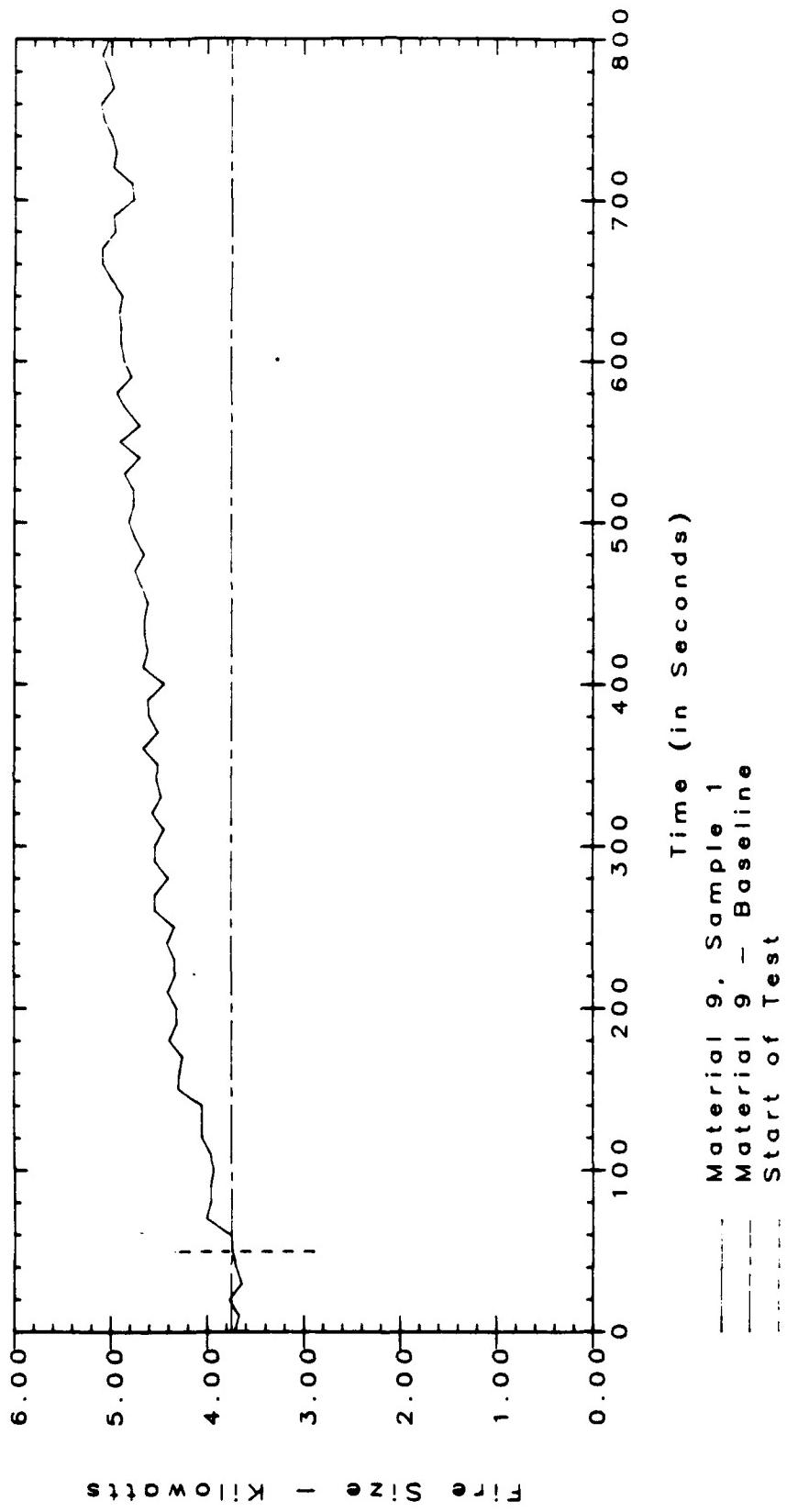
B-1.56

TEST: M9S1SP1 Specimen Number 1  
DATE: 6 November 1986  
MATERIAL: Wall Covering

USCG - IMOSURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
12	50	Flickering flames, no ignition
22	100	Flickering flames, ignition
50	200	Char; no flame
55	250	Char; no flame
80	350	Char; no flame
120	350	Char; no flame
285	400	No flame; smolder at center line

IMO FLAME SPREAD TEST



B-1.58

TEST: M9S2SP1 Specimen Number 1  
 DATE: 10 November 1986  
 MATERIAL: Wall Covering

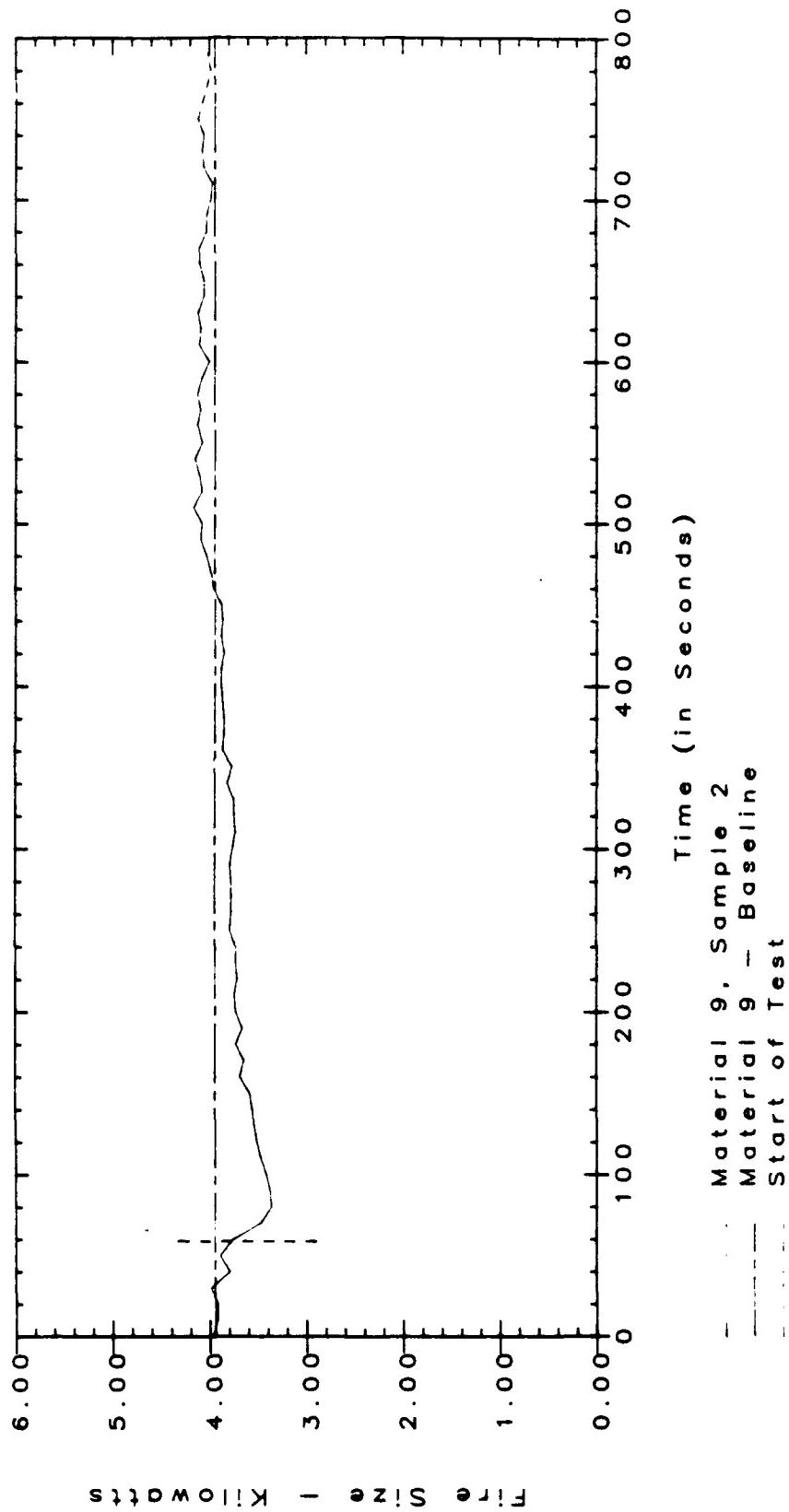
USCG - IMO SURFACE FLAMMABILITY TEST

<u>Time</u> <u>(sec)</u>	<u>Distance</u> <u>(mm)</u>	<u>Remarks</u>
5	50	Flame on center
15	50	Black char
25-40	250	Spontaneous char up to 200 mm in patches
55	0-200	Alligatoring; no flame
70	0-300	Heavy smoke
90	300	Alligatoring; charring
125	350	Alligatoring; charring
145	400	Slight blistering, dark char on top of alligatoring
160	0-400	Light smoke, decreasing; no flame; charring, blistering ceased
240	300	Dark char line
255	400	Light char; light blistering, smoke
300	0-50	Vinyl starting to separate from original backing; turning white up to 150 mm
340	450	Blistering; light char
370	0-50	Vinyl separating width of the sample
390	0-200	Char turning white; no flame
420	0-100	Vinyl separating from backing; starting to fall
440	450	Char line
465	0-150	Material starting to fall off

Sample Description at End of Test

515	0-200	Vinyl peeled from the center line, the width of the sample
520	450	Char line

IMO FLAME SPREAD TEST



TEST: M9S3SP1 Specimen Number 1  
DATE: 12 November 1986  
MATERIAL: Wall Covering

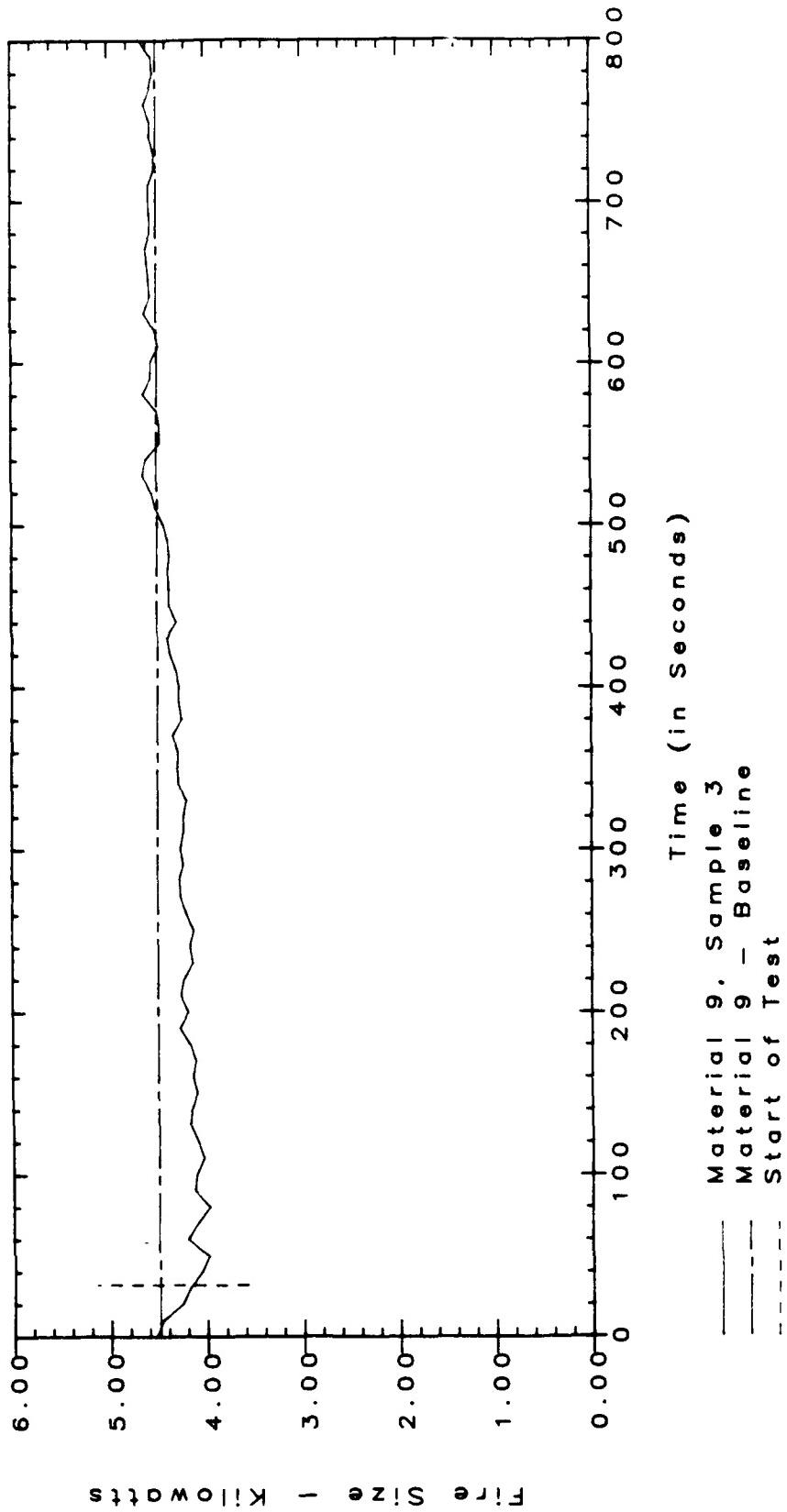
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
12	50	Light smoke; spontaneous char
28	200	Light patching char across surface
35	250	No flame
50	0-200	Light patch of char starting to alligator
60		Moderate smoke; no flame
85	300	Char line; no flame; moderate smoke
120	0-250	Complete alligatoring
135	350	Char line
165		Moderate smoke
260	0-300	Dark char line; alligatoring
270	300-400	Light char
285	0-150	Material turning to white char
340	0-150	Complete white above center line
355		Light smoke
370		No flame
450	0-100	Starting to peel off backing
485	0-150	Material peeling off backing; light smoke
510	0-200	White char
530		No flame
610	0-200	Material has peeled off original backing only around edges of sample
630	200-350	Dark brown char line
635	350-450	Light brown char line

Sample Description at End of Test

765	0-200	Material completely off original backing except around edges
780	200-250	White char line
785	250-400	Dark brown char line
790	400-460	Light brown char line
810		Very little smoke; char line ceased progression

IMO FLAME SPREAD TEST



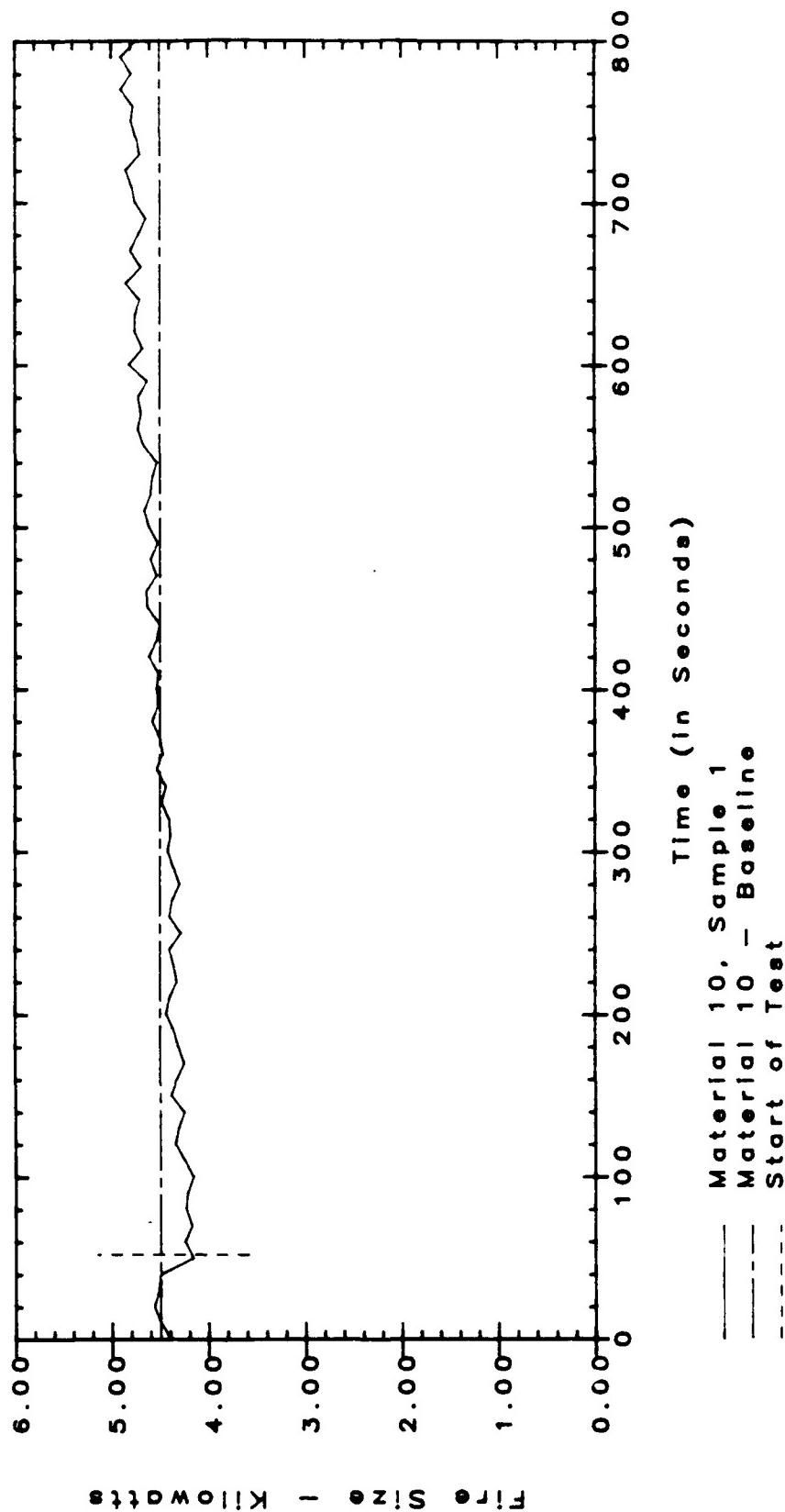
B-1.62

TEST: M10S1SP1 Specimen Number 1  
DATE: 7 November 1986  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
90	150-200	Char; no flame
105	400	Bubbles up to 400 mm
130	250	Char; no flame
150	600	Bubbles
210	300	Char, front; no flame
300	350	Char, front; no flame
330	550	Bubbles on surface, 6.35 mm diameter
340	500	Bubbles width of surface, 6.35 mm diameter

IMO FLAME SPREAD TEST



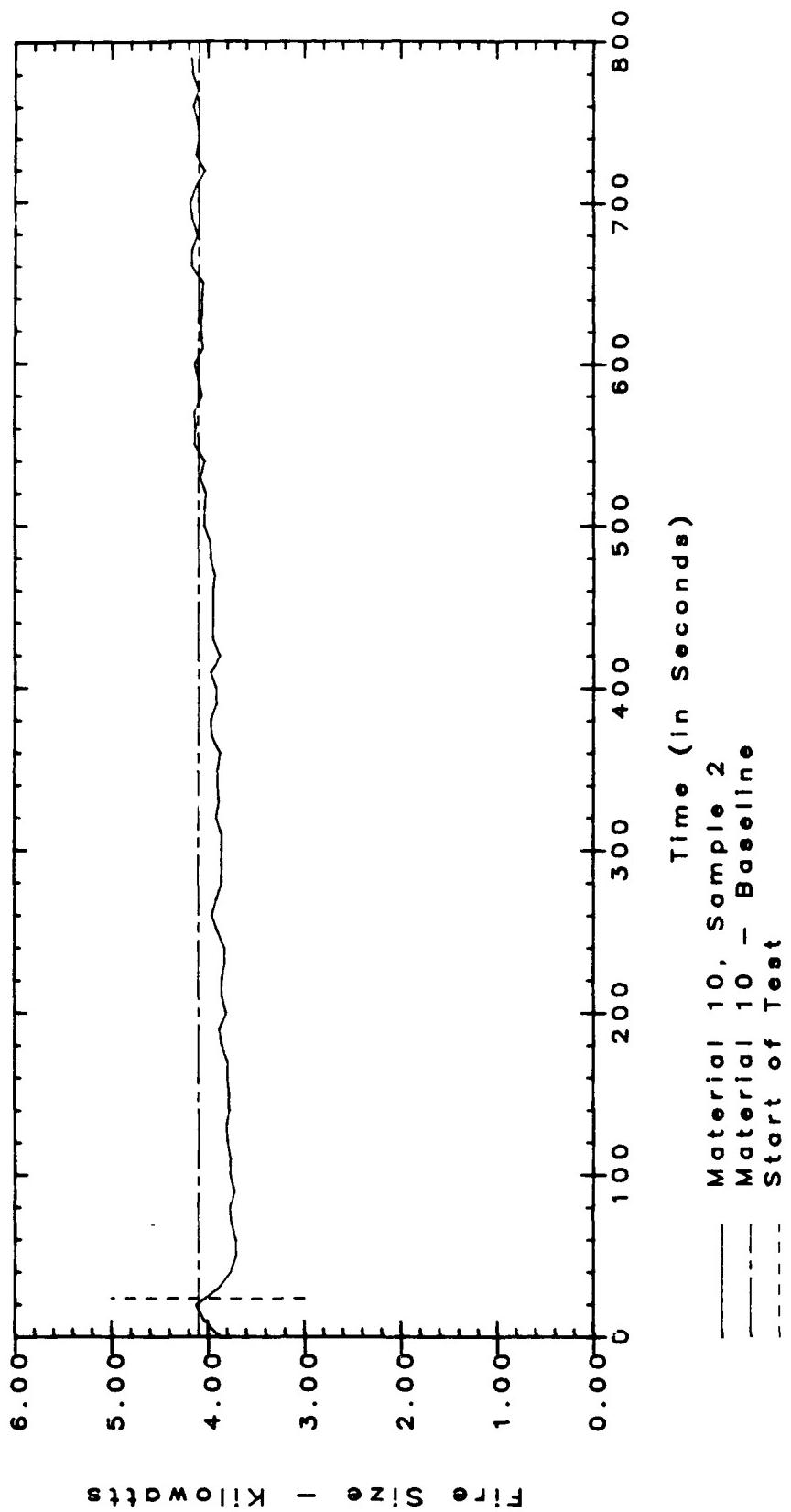
TEST: M10S2SP1 Specimen Number 1  
 DATE: 10 November 1986  
 MATERIAL: Wall Covering

<u>Time</u> <u>(sec)</u>	<u>Distance</u> <u>(mm)</u>	<u>Remarks</u>
15	0-200	Spontaneous bubbling
20	50	Char at pilot impinging flame
28	300	Bubbles; light smoke
43	350	Surface bubbles, 1.60 mm - 3.18 mm diameter; no flame
65	400	Surface bubbles
73	150	Char line
90		Heavy smoke at char line
115	450	Bubbles progressed
130	250	Complete char starts to alligator; moderate smoke
145	250-450	Bubbles 3.18 mm diameter
170	500	Surface bubbles
250	550	Surface bubbles
315	350	Char line
325	350-600	Bubbles
345	550-600	12.70 mm off surface, 12.70 mm bubbles; smoke decreased
420	0-150	Surface turning white
427	150-375	Dark brown to black char
435	375-625	Bubbles on surface
515	400	Char line
540	650	Forward bubbles below center line
560	0-250	Dark char turning white
570	250-400	Dark char
575	400-650	Bubbles

Sample Description at End of Test

665	0-250	Turned white
675	250-425	Dark char
685	425-650	Bubbles

IMO FLAME SPREAD TEST



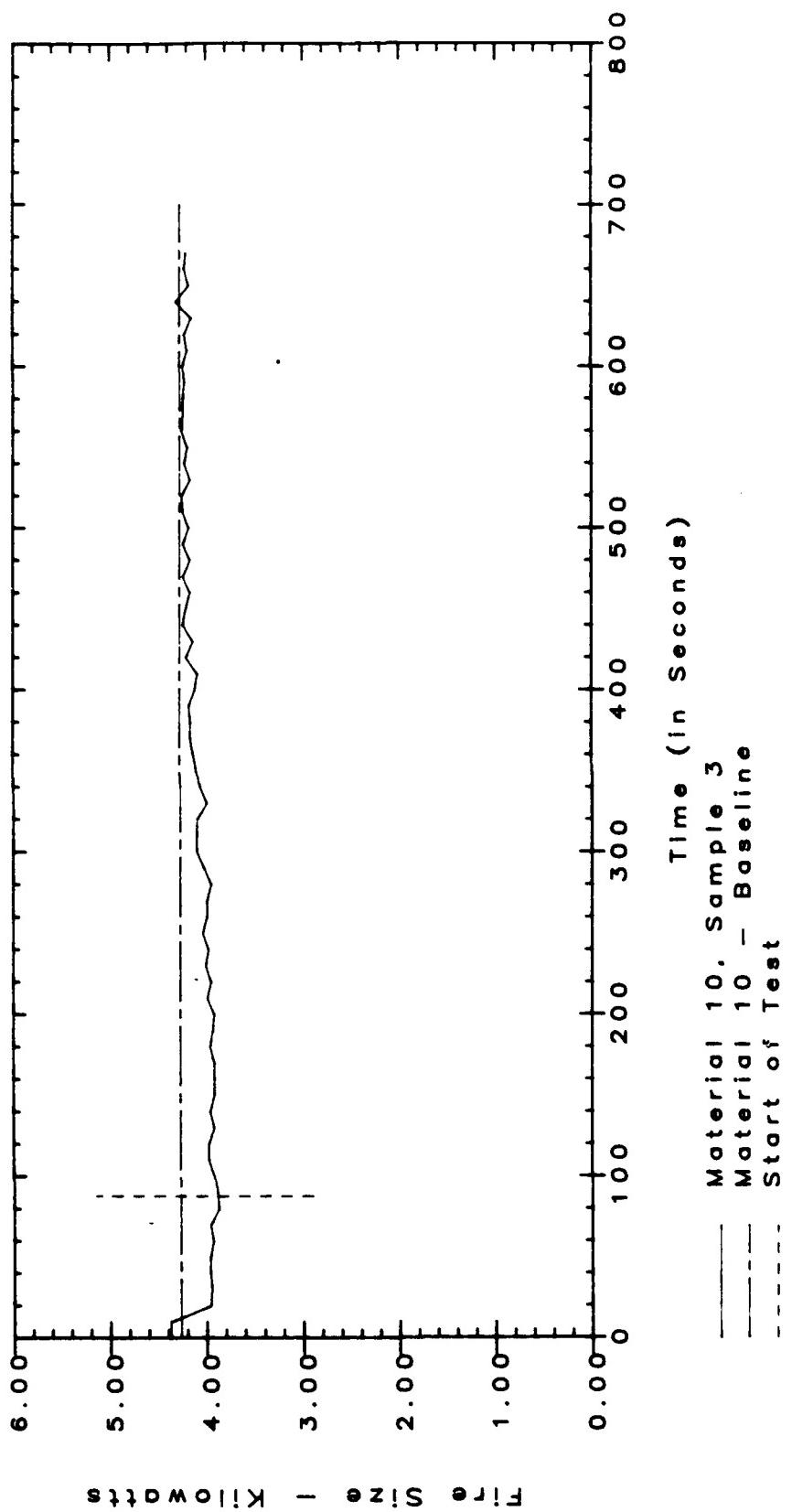
TEST: M10S3SP1 Specimen Number 1  
 DATE: 12 November 1986  
 MATERIAL: Wall Covering

Time (sec)	Distance (mm)	Remarks
10	150	Spontaneous bubbling
12	200	Spontaneous bubbles
15	250	Spontaneous bubbling, 1.70 mm - 3.18 mm diameter starting to smoke
20	300	Bubbles
35	350	Bubbles; heavy smoke; no flame
60	150	Spontaneous char
65	400	Bubbles
70		Heavy smoke from char; no flame
95	450	Bubbles on center line
110	0-200	Black char line; starting to alligator
120		Heavy smoke
135	250	Char line
150	500	Bubbles on center line 6.35 mm diameter
180		Smoke has decreased; following char line
200	300	Char line, vertical
245	550	Bubbles on center line
300	600	Bubbles above center line
305	550	Bubbles below center line
310	350	Char line, light smoke
315		Bubbles 12.70 mm diameter
355	0-100	Light white char
405	650	Bubbles on center line
415	0-150	White char
450	400	Black char
460	600	25.40 mm diameter bubbles, 6.35 mm off surface
480		Light smoke; no flame
495	200	White char
570		Light smoke

Sample Description at End of Test

585	0-275	White char
600	425-650	Bubbles on center line
620	675	Bubbles above center line

IMO FLAME SPREAD TEST



**APPENDIX B - II**

TEST: M1CDS1SP2 Specimen Number 1  
DATE: 17 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

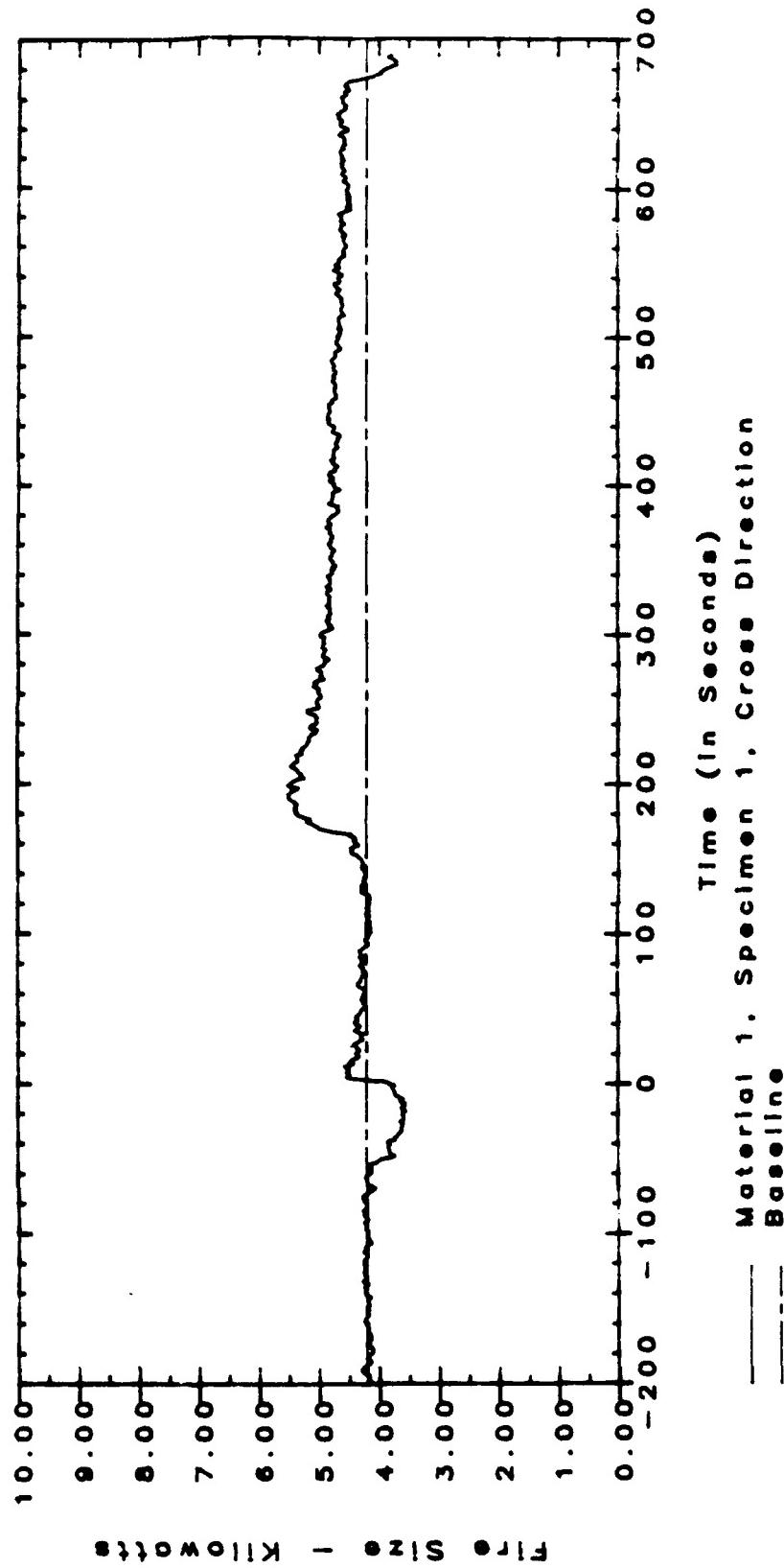
Time (sec)	Distance (mm)	Remarks
25	up to 100	Spontaneous explosions and cracking
32	0-50	Char and heavy smoke
35	200-250	Bubbles on surface
40	0-50	Slight intermittent surface flame
48-55	200	Dark char, alligatoring on surface
60	350	Bubbles have continued
68	0-50	Intermittent surface flames have ceased
75	0-300	Total surface from 0-300mm completely black char
85	350	Explosive delamination, below center line
105	400	Bubbles on surface
110-120	350	Dark char up to 350mm, material flaking and separating from original backing
130	400	Surface bubbles
140	0-50	Material turning white
150	425	Explosive delamination
170	450	Bubbles on surface above and below center line
188	400	Material separating from backing and complete char
195	0-200	Material has intermittent flaming, material is burning. Orange in color, across surface
225	up to 300	Material is falling off sample, flames up to 300mm, no actual flame spread, material about 2" off backing
245	up to 300	Bubbles up to 475mm, flame up to 300
250		Flaming has ceased
290		Red charred material falling off sample
310	500	Surface bubbles have progressed above and below center line
331	450	Char line
385	0-200	Material has delaminated completely from backing
397	100	Red charred material at 100mm below center line, about 2" from backing

TEST: M1CDS1SP2 Specimen Number 2 (cont'd)  
DATE: 17 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
415	100-150	Material has separated from backing, still attached to original material
430	150-300	Material is raised from backing but still attached to original material, complete black char
448		Pyrometer 3.94mv
495	250	At centerline, intermittent flames, material flaking off
520	0-200	Material has separated from original backing
527	200-250	Slight separation, intermittent flames
538	250-450	Complete black char, surface bubbles up to 550mm Pyrometer 3.97mv
555		All activities have ceased
590		
618	0-250	Final appearance, material has completely separated from backing of specimen
629	250-300	Material has separated from backing but still attached to the rest of the material on specimen
644	250-450	Complete black char
655	450-500	Surface bubbles above and below centerline
665		Pyrometer 3.95mv Test complete

IMO FLAME SPREAD TEST



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TEST: M1CDS2SP2  
 DATE: 21 July 1987  
 MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

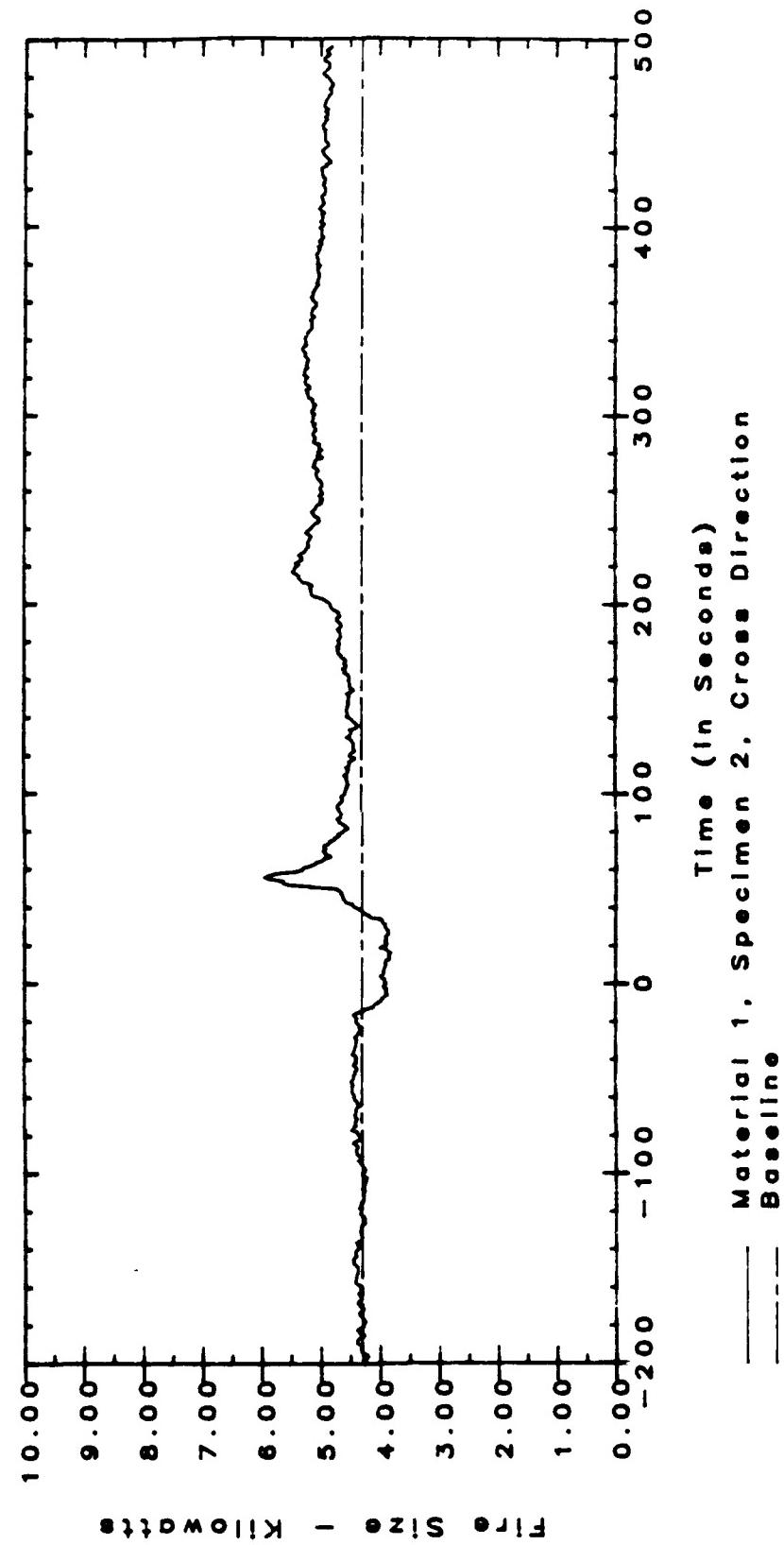
Time (sec)	Distance (mm)	Remarks
10		Pyrometer 3.76mv
25	up to 150	Spontaneous explosions and cracking
30	up to 200	Explosions, black char, heavy black smoke
40-45	up to 250	Explosions and bubbles up to 250mm, black char up to 200mm, heavy smoke, no flame
50-60	up to 300	Explosions, complete black char up to 250mm, bubbles up to 300mm, heavy black smoke, alligated surface
68		No flame
83-95	up to 350	Bubbles up to 350mm, moderate smoke, black char 300mm
100		Surface alligated, pyrometer 3.83mv
120-130	up to 350	Moderate smoke, black char line up to 350mm, bubbles up to 400mm, across surface
145-160	100	Alligated surface is separating from specimen, raised off backing about 1", light smoke
175	0-50	Turning white char, raised off surface 1 1/2"
188	450	Light smoke, bubbles progressed up to 450mm
202	400	Dark char line progressed up to 400mm
210-222	0-200	Intermittent flame on material that separated from specimen, material turned to red char
235		No flame spread, pyrometer 3.94mv
270	100-200	Intermittent flames below the center line
285	100-200	Material turning white char, starting to flake from specimen
290		Light smoke
302		Pyrometer 3.97mv
325	0-200	Laminate separated and falling from specimen
332	200-250	Intermittent flames, material raised 1" off backing

TEST: M1CDS2SP2 Specimen Number 2, (cont'd)  
DATE: 17 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
344	250-300	Material is raised on centerline from backing
355	300-425	Complete black char line
360	425-500	Bubbles across surface
368	450	Very light smoke, intermittent flames out at 450mm, no flame spread
382		Pyrometer 3.98mv
430		Pyrometer 3.97mv
445	0-250	Material fallen off specimen
455	250-350	Material raised from backing on center line
465	350-450	Complete black char and alligated surface
475	450-525	Bubbles on surface above and below center line
485		Pyrometer 3.97mv, test secured

IMO FLAME SPREAD TEST



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TEST: M1CDS3SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

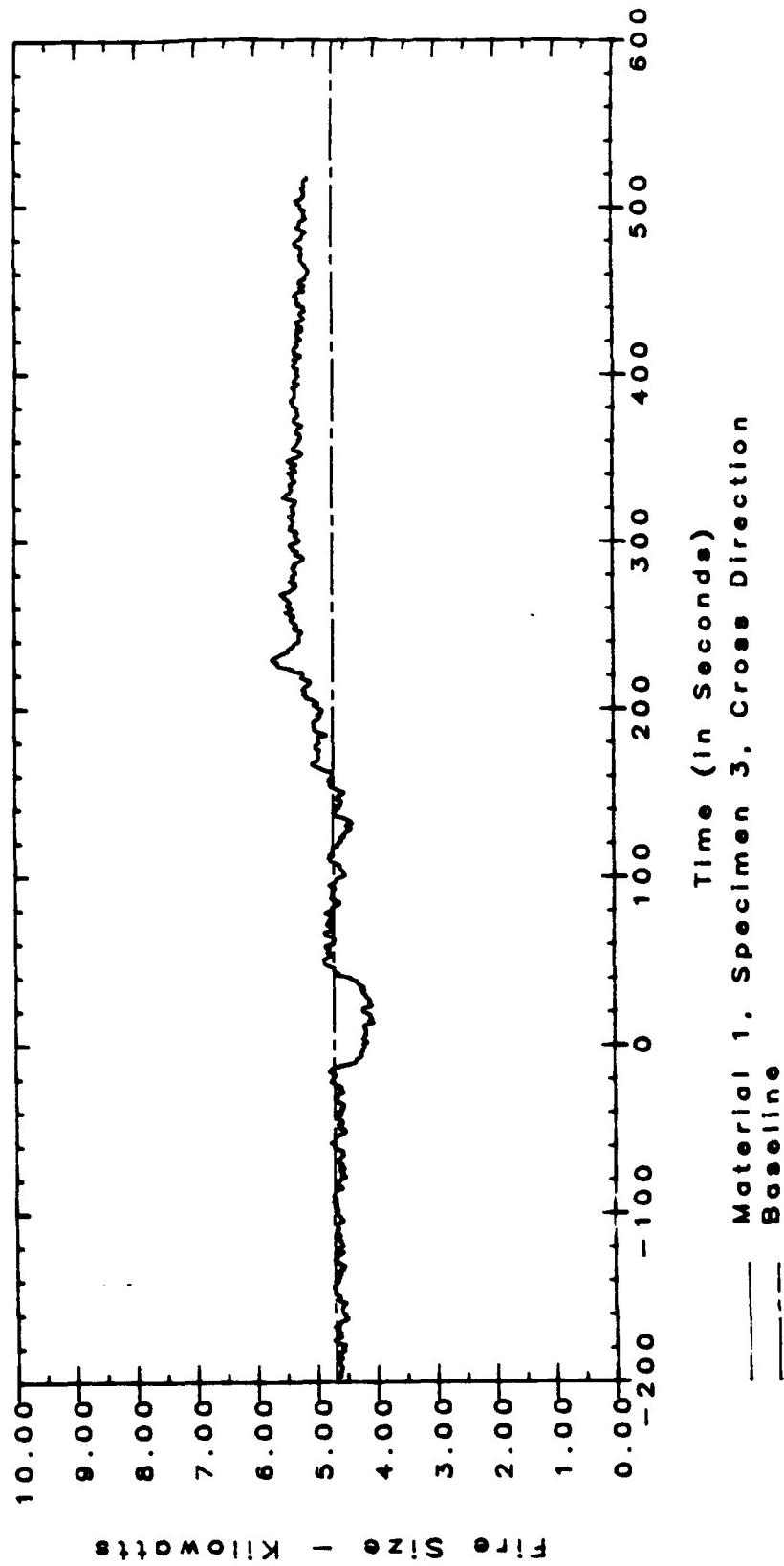
Time (sec)	Distance (mm)	Remarks
9		Pyrometer 3.84mv
25-32	150-200	Spontaneous explosions
35-40	0-50	Moderate smoke, bubbles, surface charring
45	up to 200	Charring up to 200mm, bubbles up to 275mm, heavy smoke
48	up to 200	Complete black char
60	250	Delamination of material where bubbles had formed
65-70	up to 325	Black char up to 275, bubbles up to 325
74		Still complete black char, no flames
80		Pyrometer 3.81mv
110-110	up to 325	Moderate smoke, complete black char with alligated surface
115	400	Bubbles across surface, above and below center line
120		Moderate smoke
165	0-250	Intermittent flames on top of specimen 2" in height, material turning to white char
180	375	Dark char line
185	450	Bubbles above and below center line, light smoke
200		Pyrometer 3.88mv
210	0-50	Intermittent flames are out above center line
216		Intermittent flames have started again
220-225	up to 100	Laminate material has separated from specimen backing and raised off surface
230	200	Intermittent flames across surface, 2" into stack
245		Flames are burning material that separated and turning to red char
252	425	Light smoke, bubbles above and below center line
260		Laminate material falling off specimen
270	0-150	Intermittent flames have ceased
277	150-250	Intermittent flames, light smoke, black char

TEST: M1CDS3SP2 Specimen Number 2 (cont'd)  
DATE: 27 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
300	250	Intermittent flames are out, light smoke
312	425	Black char line
320	500	Bubbles above and below center line
326		Pyrometer 3.97mv
420		Very light smoke, no flames
430	425	Dark char line
435	450	Light char line
440	500	Bubbles above and below center line
445		Pyrometer 3.96mv
455-465	0-250	Laminate has separated and fallen off specimen, some material on edges of sample holder
470-480	250-300	Laminate is raised off of backing and turning to white char
485	300-425	Complete black char line
490	425-675	Light char
496	475-525	Bubbles above and below center line
505		No flame spread, no smoke, no further progression
515		Pyrometer 3.96mv, test secured

IMO FLAME SPREAD TEST



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TEST: M1CDS4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

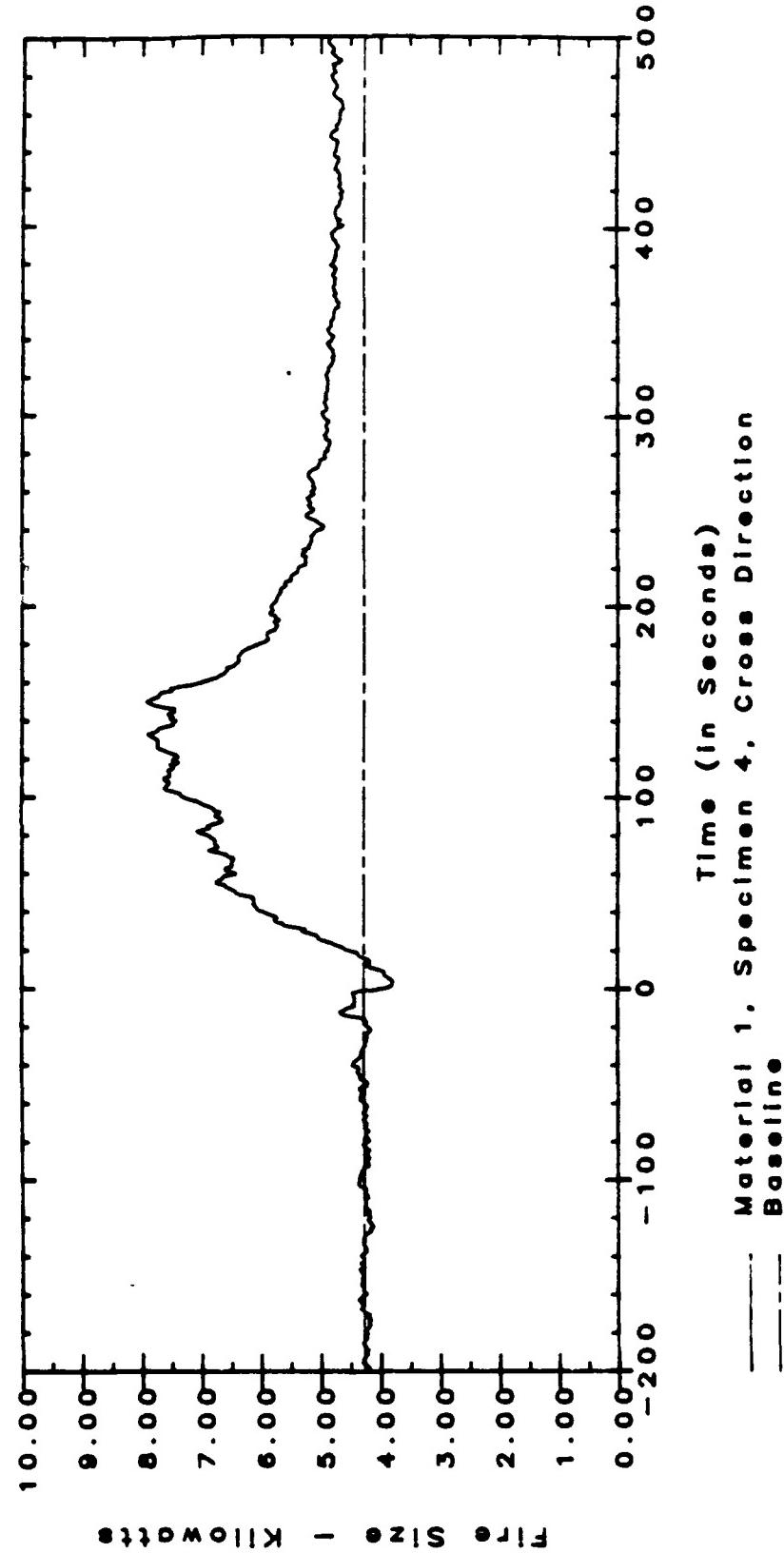
Time (sec)	Distance (mm)	Remarks
10	0-25	Spontaneous charring at impinging line
17		Pyrometer 3.75mv
27	up to 250	Spontaneous explosion
38	200	Top of bubbles are charring
48		Flame at impinging pilot, not burning material, gaseous
57	300	Explosions
60	250	Complete black char and alligated surface
65		Heavy smoke
82	0-50	Flames at impinging pilot, 3" height into stack
90	350	Bubbles across specimen above and below center line
95	300	Complete black char and alligated surface
100		Pyrometer 3.84mv
110	0-100	Flames across specimen above center line 4"
120		Flames are intermittent, flickering on and off 4" height
130	150	Progression of flames above and below center line
140-155	0-150	Moderate smoke, laminate separate and raised off specimen backing on top of sample, splitting along the center line
165	100	Material fell off specimen above center line
168	450	Bubbles across specimen above and below center line
170	300	Complete black char
175	0-100	Flames have ceased
185	100-250	Intermittent flames about 1" height off the surface, light smoke
188		Pyrometer 3.95mv
193	200	Intermittent flames have ceased
200	200-250	Intermittent flames and light smoke

TEST: M1CDS4SP2 Specimen Number 4 (cont'd)  
DATE: 27 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
207-222	0-150	Laminate has separated completely from specimen backing, except along the bottom edge of specimen, this piece is turning to white char, it is already red char
232		Pyrometer 3.94mv
243		Intermittent flames have ceased, light smoke
250	0-150	No material left on specimen except along the bottom of specimen holder
260	150-250	Laminate is raised off specimen backing turning to red and white char about 1" off backing
272	475	Progression of bubbles across specimen above and below center line
277	400	Complete black char and alligatoring, light smoke
428		Pyrometer 3.96mv, smoke ceased, no flaming
437	0-200	Laminate has fallen off specimen except for along bottom edge near specimen holder
445	200-300	Laminate raised off specimen backing about 2" in height, turning white char
460	300-450	Complete black char and alligated surface
470	450-525	Progression of bubbles above and below center line
480		Pyrometer 3.97mv, test complete

IMO FLAME SPREAD TEST



B-2.15

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B-2.16

TEST: M1CDS5SP2 Specimen Number 5  
DATE: 30 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

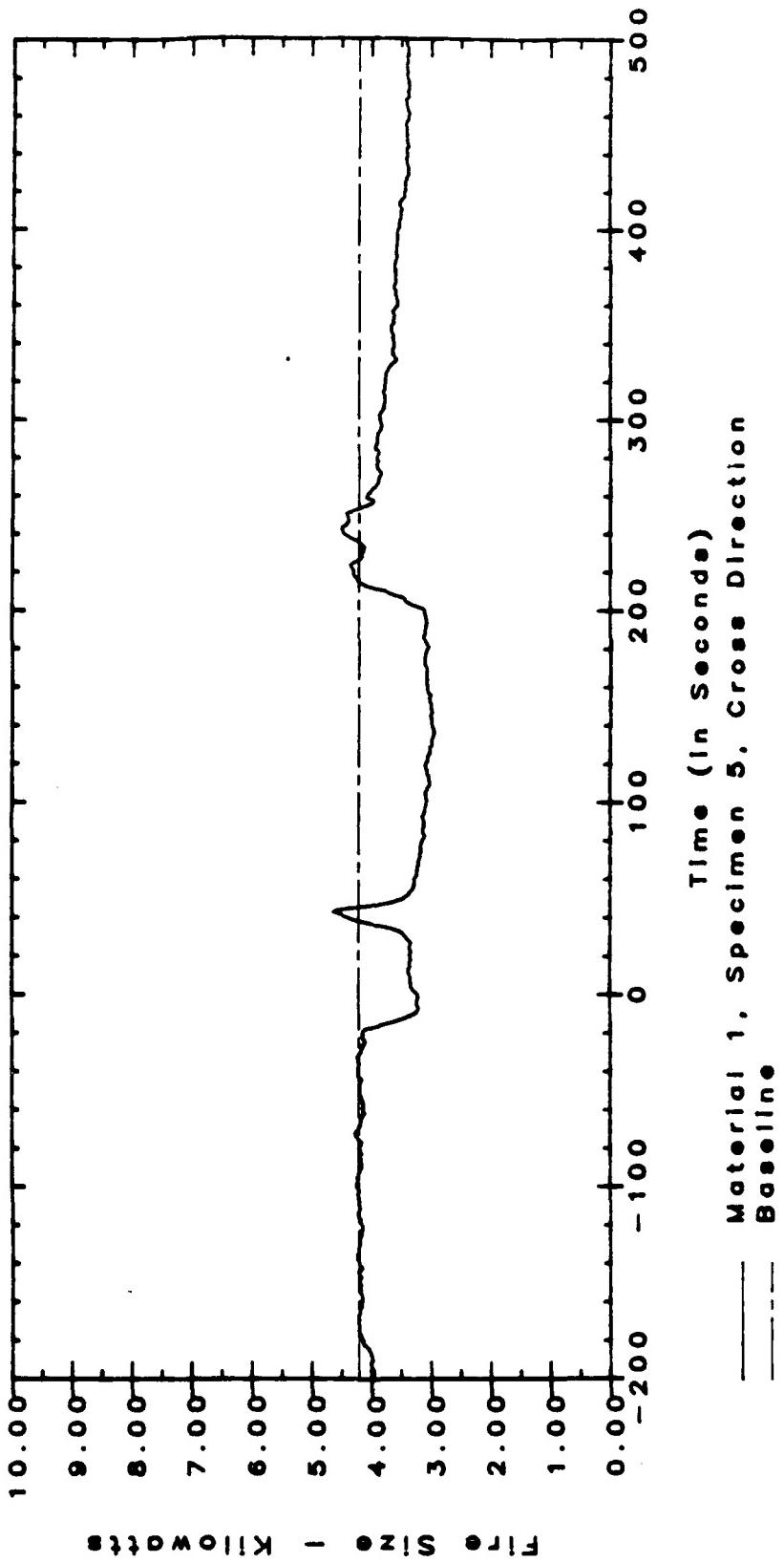
Time (sec)	Distance (mm)	Remarks
17		Pyrometer 3.71mv
25	up to 200	Spontaneous explosion
40	0-200	Spontaneous char, moderate to heavy smoke
35	250	Explosive delamination
48		Horizontal pilot flame went out, heavy black smoke
55	0-250	Complete black char and alligated surface
65	0-325	Explosive delamination
100		Pyrometer 3.76mv
115-175	350	Complete black char and heavy black smoke
120	400	Bubbles across specimen above and below center line
128	0-350	Complete alligatoring across surface
168	0-150	Laminate has raised off specimen backing about 1" (height), moderate smoke
225-240	0-100	Intermittent flames turning laminate to red char, material has separated from backing, pilot flame is trying to ignite now, secured fuel gas
275	0-200	Intermittent flames about 1" off surface turning laminate to red char
285	0-100	Laminate has fallen off specimen except for bottom edge by sample holder, light smoke
340	0-150	No laminate left on specimen
348	150-200	Laminate is red char with light intermittent flames and light smoke
360	250-425	Complete black char with alligatoring
370	425-500	Bubbles above and below center line
475		Pyrometer 3.89mv, all activities have ceased
485	0-250	Specimen has no material left on it

TEST: M1CDS5SP2 Specimen Number 5 (cont'd)  
DATE: 30 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
495	250-350	Material is raised off specimen back about 1" height and alligated surface
505	300-450	Complete black char line
515	450-525	Bubbles above and below center line
530		Pyrometer 3.89mv, test complete

IMO FLAME SPREAD TEST



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TEST: M1MDS1SP2 Specimen Number 1  
DATE: 17 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

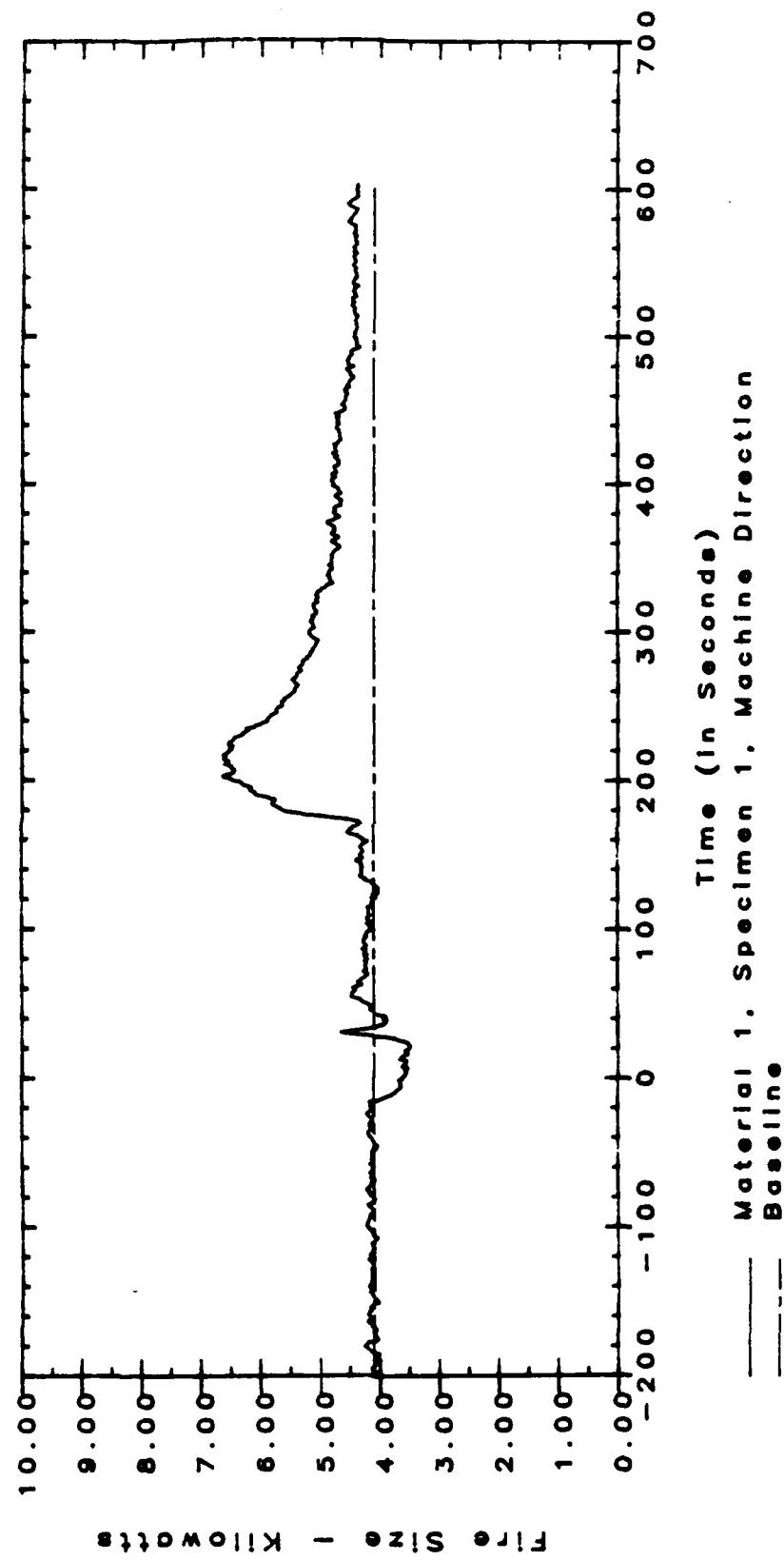
Time (sec)	Distance (mm)	Remarks
25	150-200	Spontaneous explosions on surface
32	0-50	Intermittent flaming
35		Intermittent flaming has ceased, material has separated from backing, black char
40	250-300	Surface bubbles
45-50	0-250	Surface black char, material has separated from backing, heavy smoke, no flames
55		Pyrometer 3.73mv
60	250	Char line, bubbles up to 350mm
70-80	0-250	Complete black char, material separating from backing, no flame, heavy white smoke
93	300	Surface has alligatored
100	350	Bubble explodes above center
110	400	Surface bubbles above and below center- line
132	200	Surface separating from backing up to 200mm, light gray smoke
135	0-50	Intermittent flaming, orange in color, decreasing smoke. Flaming from material that is separated from back
143	400	Bubble explodes above centerline
175	200	Spontaneous flaming on material that has separated from backing. No flame spread. Light surface flame
190	450	Bubbles above and below centerline
193	400	Char line
205	250	Material is separated, orange in color
214	100-250	Surface flames above centerline
232	200	Material falling off specimen, surface flames at 250mm
265	500	Surface bubbles up to 500mm above the centerline
277	250	Flaming has ceased
295	0-250	Material has fallen off above centerline
315	0-250	Material has raised off backing 1 1/2" below centerline
321	250-400	Material has raised off backing but still attached to original sample

TEST: M1MDS1SP2 Specimen Number 1 (cont'd)  
DATE: 17 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
335		Flaming and smoke have ceased
350	420-500	Surface bubbles up to 500mm, char line at 420mm across the surface of specimen
363		Pyrometer 3.91mv, 600 seconds into test
395	450-525	Char line up to 450mm across specimen, surface bubbles up to 525mm with light alligatoring
410		All reactions have slowed down
428		No flaming, no smoke
435	50	Material fell off specimen 50mm below centerline
455	50-200	Very little material left on specimen
472		Pyrometer 3.91mv 700 seconds into test
495	0-250	Final appearance delamination and separating of material from backing
520	250-350	Material raised off backing 1"
544	300-450	Black char across surface with slight alligatoring
555	525	Bubbles up to 525mm. Test complete 800 seconds

IMO FLAME SPREAD TEST



B-2.23

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B-2 .24

TEST: M1MDS2SP2 Specimen Number 2  
DATE: 21 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

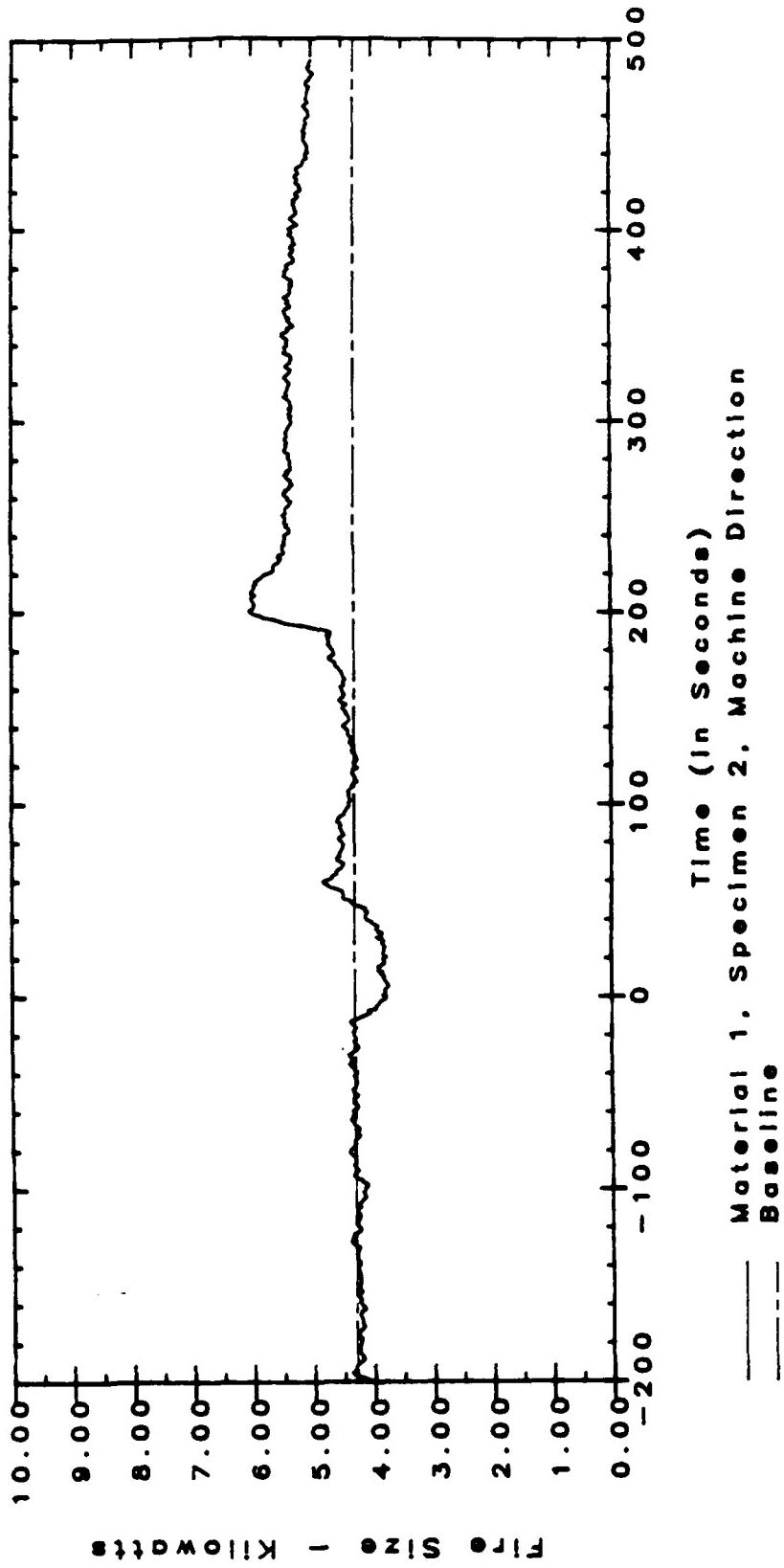
Time (sec)	Distance (mm)	Remarks
11		Pyrometer 3.79mv
25-30	up to 200	Spontaneous explosions and cracking
35		Moderate smoke, starting to char
40	up to 350	Explosion of bubbles, heavy smoke
45-58		Material is breathing, bubbles releasing air, and separating from the backing, heavy black smoke into stack
60	up to 300	Bubbles up to 300mm, complete black char up to 250mm, black smoke, surface alligatored
70-75	up to 350	Bubbles up to 350mm, moderate smoke, black char 300mm
85		Pyrometer 3.83mv
95		No flames
105		Moderate smoke
120	350-400	Surface bubbles up to 400mm, black char up to 350mm
145	100-150	Material is raised from specimen across the center line
160	0-50	Material is raised from specimen about 1", light smoke
170		Pyrometer 3.89mv
195	up to 200	Intermittent flame up to 200 mm, burning material that is separated from specimen
210		No flame spread, flames about 1" in height, light smoke
230	0-100	Material flaking off specimen, light smoke, red char
240		Pyrometer 3.96mv
295	0-100	Intermittent flames ceased
305	100-150	Continued intermittent flames
312	0-250	Material is separated from specimen, red char
325	250-350	Material is raised off specimen about 1"
333	350-425	Complete black char across the surface, alligatored
340	425-500	Bubbles across surface above and below center line
347		Pyrometer 3.98mv
357		No flames, light smoke

TEST: M1MDS2SP2 Specimen Number 2 (cont'd)  
DATE: 21 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
420		Pyrometer 3.98mv
437	0-250	Final appearance: Material separated and fallen off specimen
445	250-350	Material is raised off specimen, still attached
453	350-450	Complete black char above and below center line
460	450-525	Surface bubbles above the center line
473		No smoke, no flame spread

IMO FLAME SPREAD TEST



B-2.27

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TEST: M1MDS3SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
11		Pyrometer 3.81mv
25-31	150-200	Spontaneous explosions across surface
36	up to 200	Bubbles are charring, heavy black smoke
42	250	Bubbles progress across surface
45		No flames, complete black char and heavy smoke
52	300	Bubbles above and below center line
60	250	Black char, heavy smoke, and surface alligatoring
70	up to 350	Explosions across face of surface
80		Heavy smoke, no flames
85		Pyrometer 3.86mv
100	350	Moderate smoke, complete black char and alligatoring
108	400	Bubbles above and below center line
135-145	0-100	Laminate material is raising off specimen backing, moderate smoke, material still attached
162-185	0-100	Material has separated, still attached, surface is charring, spontaneous intermittent flames up to 150mm, 3" into stack, material turning to red char
190		Moderate flames, burning material that has separated from specimen
200	400	Complete black char
205	450	Bubbles above and below center line
218		Pyrometer 3.97mv
230-252	200	Flames progressed 200mm, ;" into stack, burning laminate that separated from specimen, turning to red char
275	0-150	Intermittent flames have ceased
285	150-250	Intermittent surface flames 1" height
290-305	0-200	Material has separated from specimen starting to fall off, white and red char
315	500	Bubbles above and below center line

TEST: M1MDS3SP2 Specimen Number 3 (cont'd)

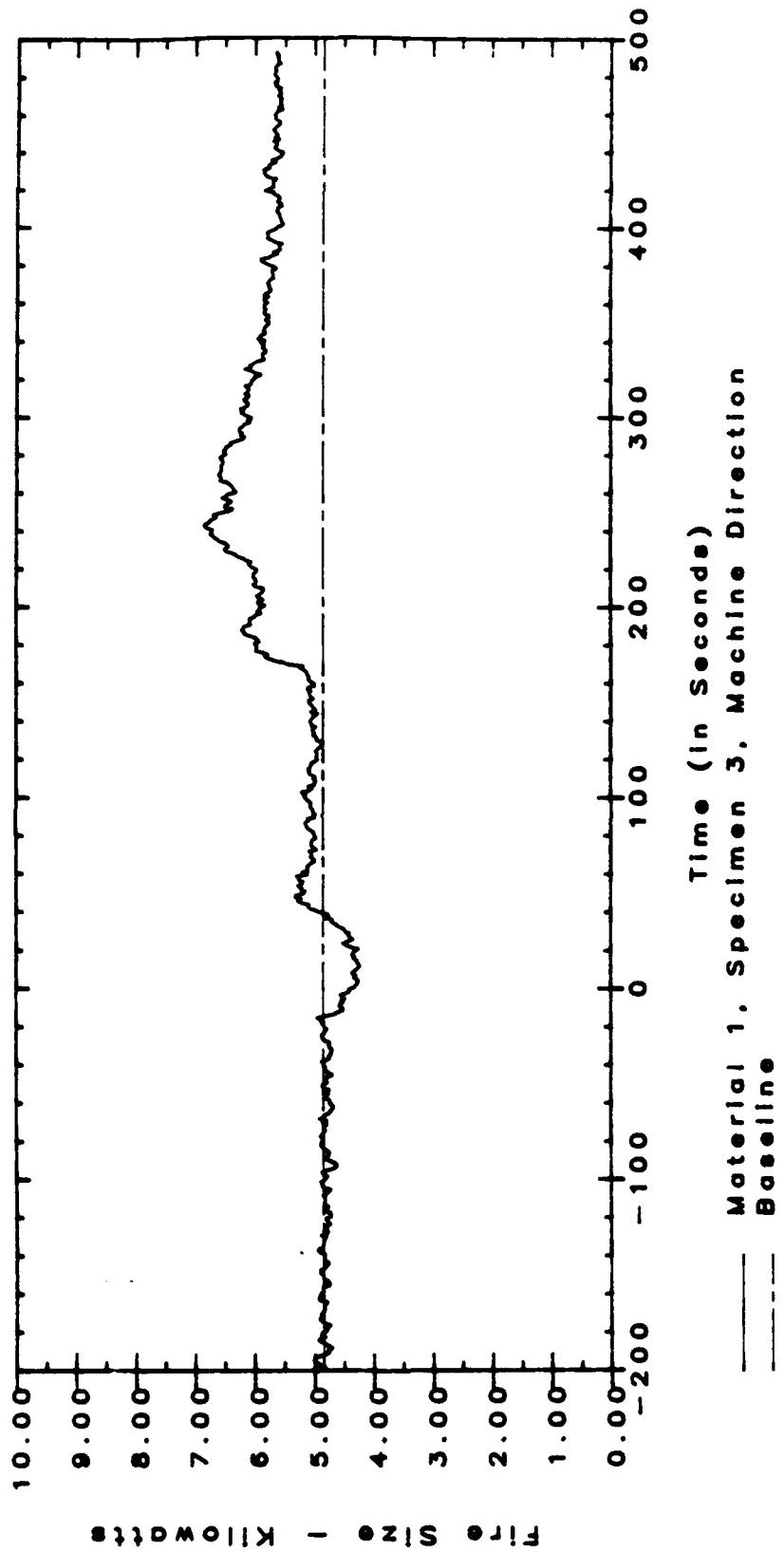
DATE: 27 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
320	425	Complete black char
330	250	Intermittent flames ceased, very light smoke
337		Pyrometer 4.02mv
420		Pyrometer 4.02mv, all activities ceased
435-445	0-250	All material has fallen off specimen except for some around the edges of specimen holder
450-460	250-350	Material is raised off specimen backing about 1" but still attached
465	350-425	Complete black char with surface alligatoring
475	425-525	Bubbles above and below center line
485		No flame spread, test secured

IMO FLAME SPREAD TEST



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TEST: M1MDS4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

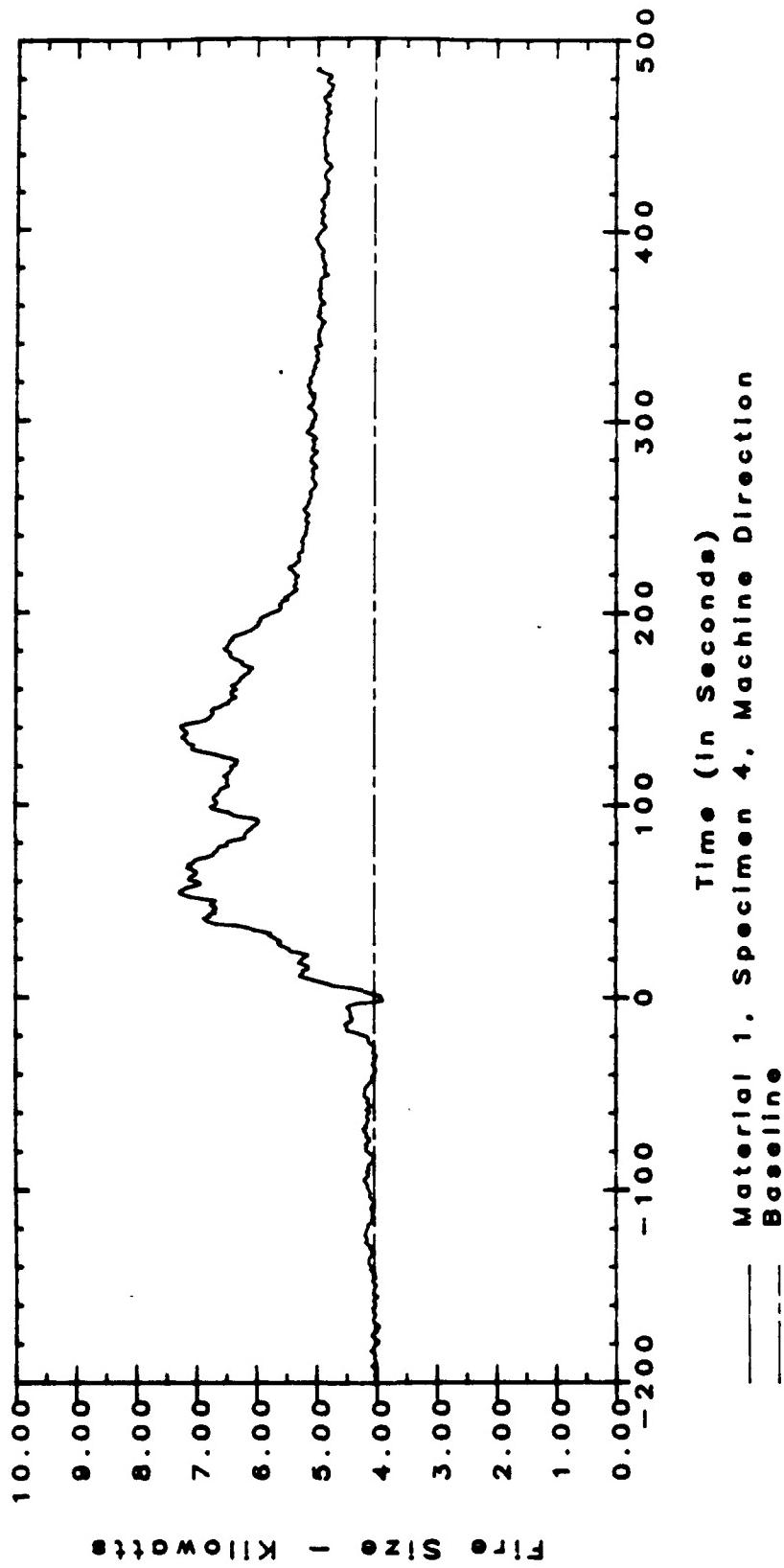
Time (sec)	Distance (mm)	Remarks
12	0-25	Spontaneous charring at impinging pilot
23	up to 200	Spontaneous explosion
33	0-200	Complete black char with char on top of bubble
41	250	Progression of bubbles, heavy black smoke
50	100	Laminate has separated from specimen backing, this is the bubble that exploded at the beginning
55	0-50	Flame about 4" height into stack
75	0-50	Laminate is raised off backing, moderate smoke
80		Pyrometer 3.82mv
90	350	Progression of bubbles, moderate smoke
95	300	Progression of black char, alligated surface
110	0-100	Laminate is raised off backing with intermittent flames about 3" in height above center line
130	0-150	Intermittent flames across surface 4" in height
132	425	Progression of bubbles and moderate smoke
142	350	Complete black char line
155	0-100	No laminate left on specimen except along bottom edge of specimen holder
162	100-200	Material has raised off specimen backing
175	250	Light to intermittent flames, 3" height into stack
185		Pyrometer 3.94mv
195	450	Progression of bubbles
198	400	Progression of black char line
202	250	Intermittent flames have ceased except for on top of specimen holder, moderate smoke
219	0-200	Laminate has fallen off specimen
225		All intermittent flames have ceased
247		Pyrometer 3.94mv, light smoke

TEST: M1MDS4SP2 Specimen Number 4 (cont'd)  
DATE: 29 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
255	0-200	No material is left on specimen backing except along the bottom edge of specimen holder
270	200-300	Laminate is raised off specimen backing about 2" and turning white char
285	300-400	Alligatored surface and black char line
295	400-500	Bubbles across specimen, above and below center line, light smoke
410		Pyrometer 3.94mv, all smoke has ceased
420-430	0-300	All material has fallen off of specimen holder except for along the bottom edge of specimen holder
435	300-350	Laminate has raised off specimen backing about 2" and turning white char
445	350-450	Complete black char and alligatored surface
455	450-525	Bubbles across surface above and below center line
465		Pyrometer 3.94mv, no flame spread, test complete

IMO FLAME SPREAD TEST



B-2.35

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B-2.36

TEST: M1MDS5SP2 Specimen Number 5  
DATE: 30 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

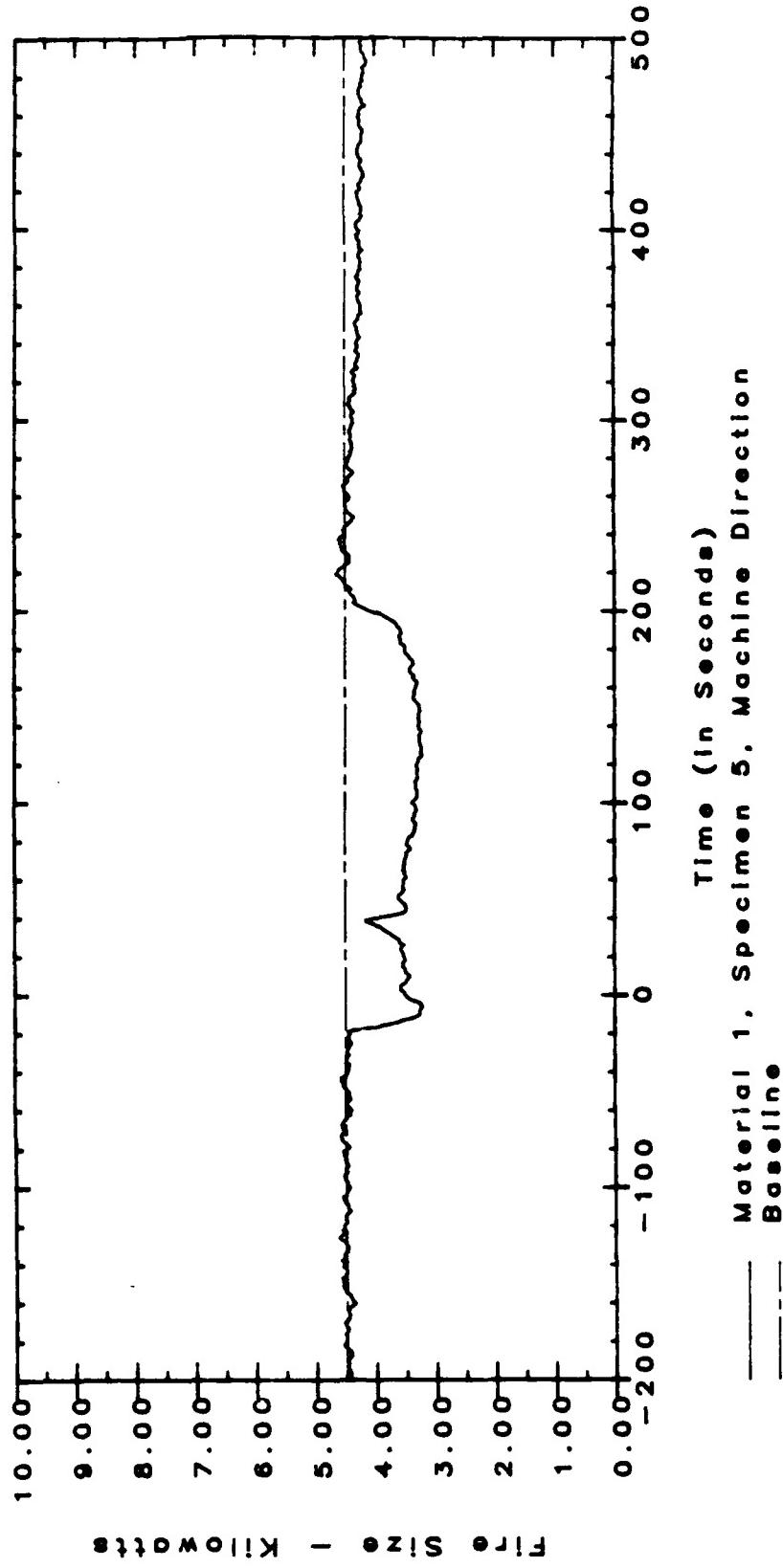
Time (sec)	Distance (mm)	Remarks
17		Pyrometer 3.71mv
24	up to 200	Spontaneous explosions
35	150	Black char across surface, moderate to heavy smoke
40	250	Bubbles across surface
42	200	Complete black char
45		Horizontal pilot flame went out, secured fuel gas
55	300	Bubbles across surface, heavy black smoke
60	250	Complete black char and alligatoring
120		Pyrometer 3.78mv
125	400	Bubbles above and below center line
133	350	Complete black char with surface alligator, moderate smoke
167-180	0-250	Material is separating from backing with a split along center line, raised off backing about 1", turning to white char
188	200-350	Alligated surface, moderate to light smoke
195	375	Complete black char
200	400	Bubbles above and below center line
205	0-150	Intermittent flames, material turning to red char
222-235	200	Intermittent flame about 1" off surface, material turning white and starting to flake off specimen
300		Intermittent flames have ceased
308-320	0-200	Material is red with char and has fallen off specimen, some material is left around edges
328	200-300	Material is raised off backing about 2" but is still attached, light smoke
340	300-425	Complete black char
348	425-500	Bubbles above and below center line
354		Pyrometer 3.91mv

TEST: M1MDS5SP2 Specimen Number 5 (cont'd)  
DATE: 30 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
380-392	300	Intermittent flames 1/2" off surface, very small, can hardly see them, material turning to red and white char and raised off specimen about 2" from backing
465		Intermittent flame and smoke have ceased
475		Pyrometer 3.92mv
490	0-200	Material has fallen off specimen except for around the edges
500	200-300	Material is raised off backing but is still attached, turning to red and white char
510	300-325	Complete black char and alligated surface
515	325-525	Bubbles above and below center line
525		Pyrometer 3.91mv, test complete

IMO FLAME SPREAD TEST



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TEST: M2CDS1SP2 Specimen Number 1  
DATE: 20 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

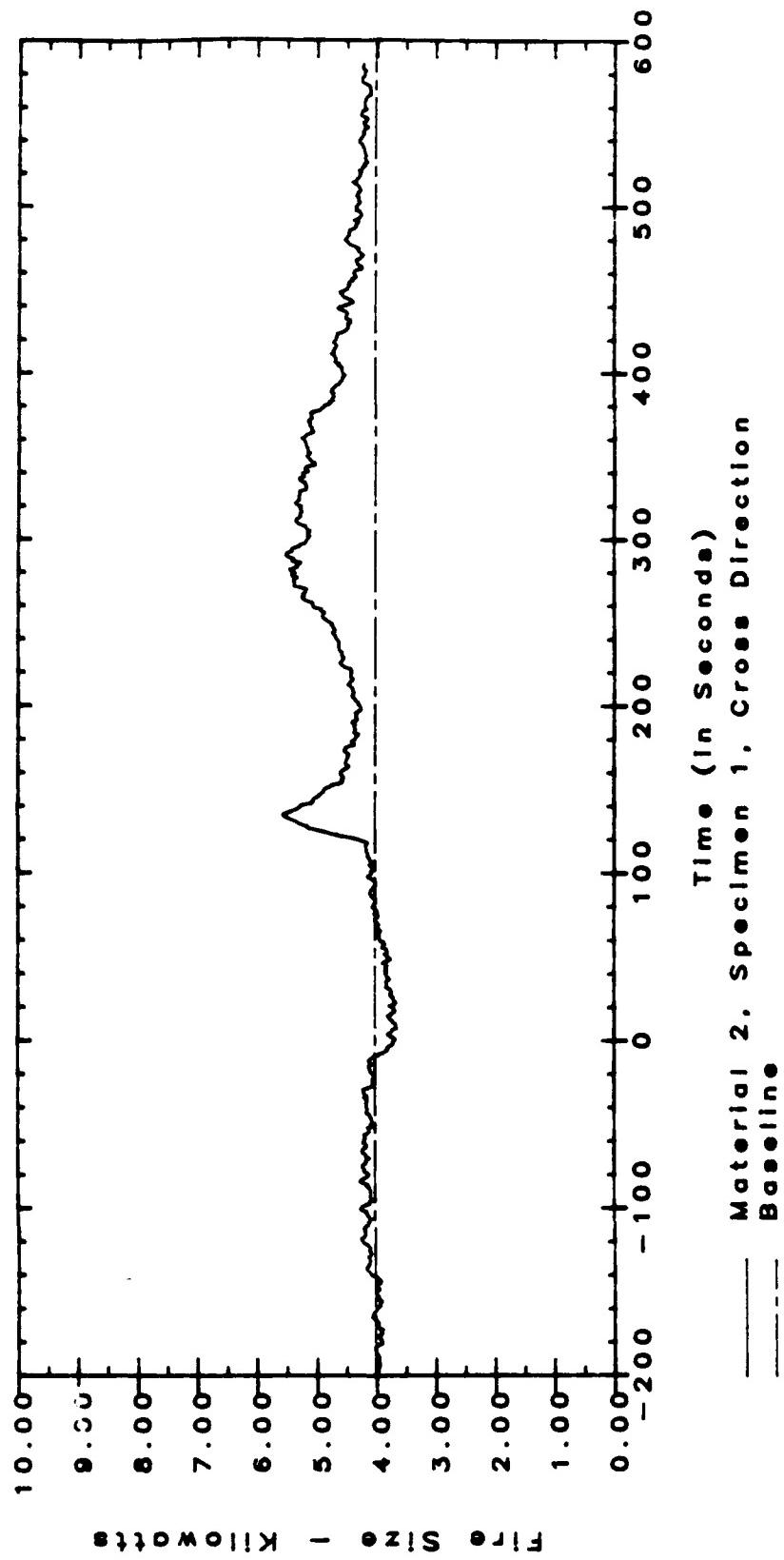
Time (sec)	Distance (mm)	Remarks
25-35	150-200	Spontaneous explosions and cracking at 100, 150-200mm, heavy smoke, material separating at explosion site
37	up to 225	Black char
42	250	Surface delamination, black char, heavy smoke
45	up to 300	Surface bubbles and explosions, black char
48-55	up to 350	Surface bubbles, surface turns to char then explodes, heavy black smoke, surface delamination
95	0-100	Surface has separated from original backing, black char
105	100-250	Alligator from bubbles that exploded
115	100-250	Material starting to separate from backing, no flames, pyrometer 3.80mv
120	350	Black char line
125	0-50	Intermittent 0-50mm across the face of the material, flames up to 100mm
142		Flames burning material that exploded off surface about 4" into stack
148	400	Black char and explosions of bubbles increased to 400mm
155	100	Intermittent flames decreasing in size have not progressed past 100mm
165		Intermittent flames small in size, light smoke
185	0-100	Material turning white, intermittent flame above centerline, light smoke
195	250-450	Dark char line up to 250mm, light char line at 400mm, bubbles up to 450mm
223	100-200	Intermittent flames above centerline burning material that exploded
225		Pyrometer 3.88mv
235	100	Intermittent flame still burning material. Material has separated from specimen backing
245		Very light smoke, flames about 3" into stack

TEST: M2CDS1SP2 Specimen Number 1 (cont'd)  
DATE: 20 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
255	100-250	Intermittent flames increase to 250mm, burning the separated material that exploded at beginning of test
285		Pyrometer 3.92mv
290	0-50	Red char
298	50-250	Intermittent light flames on separated material
308	250	Dark char line still 250mm
315	450	Bubbles still at 450mm, light brown char line
325		No flame spread on this material, intermittent only
342	0-100	Intermittent flaming
347	100-200	No flames, material separating from specimen
353	200-250	Intermittent flaming
358		Flaming decreasing, material falling off specimen
378	0-200	Material has completely fallen off specimen
390	200-300	Material has separated from backing, black with char, but still attached to specimen
402	300-450	Light brown char line
408	450-500	Bubbles on surface
416		Light smoke, intermittent flames ceased
428		Pyrometer 3.97mv
480	0-250	Material has delaminated from original backing
488	250-400	Raised material off backing but still attached
500	450	Black char line
510	450-500	Light char line
515	525	Bubbles
540		Pyrometer 3.97, Final look total time 10 minutes

IMO FLAME SPREAD TEST



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TEST: M2CDS2SP2 Specimen Number 2  
 DATE: 21 July 1987  
 MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

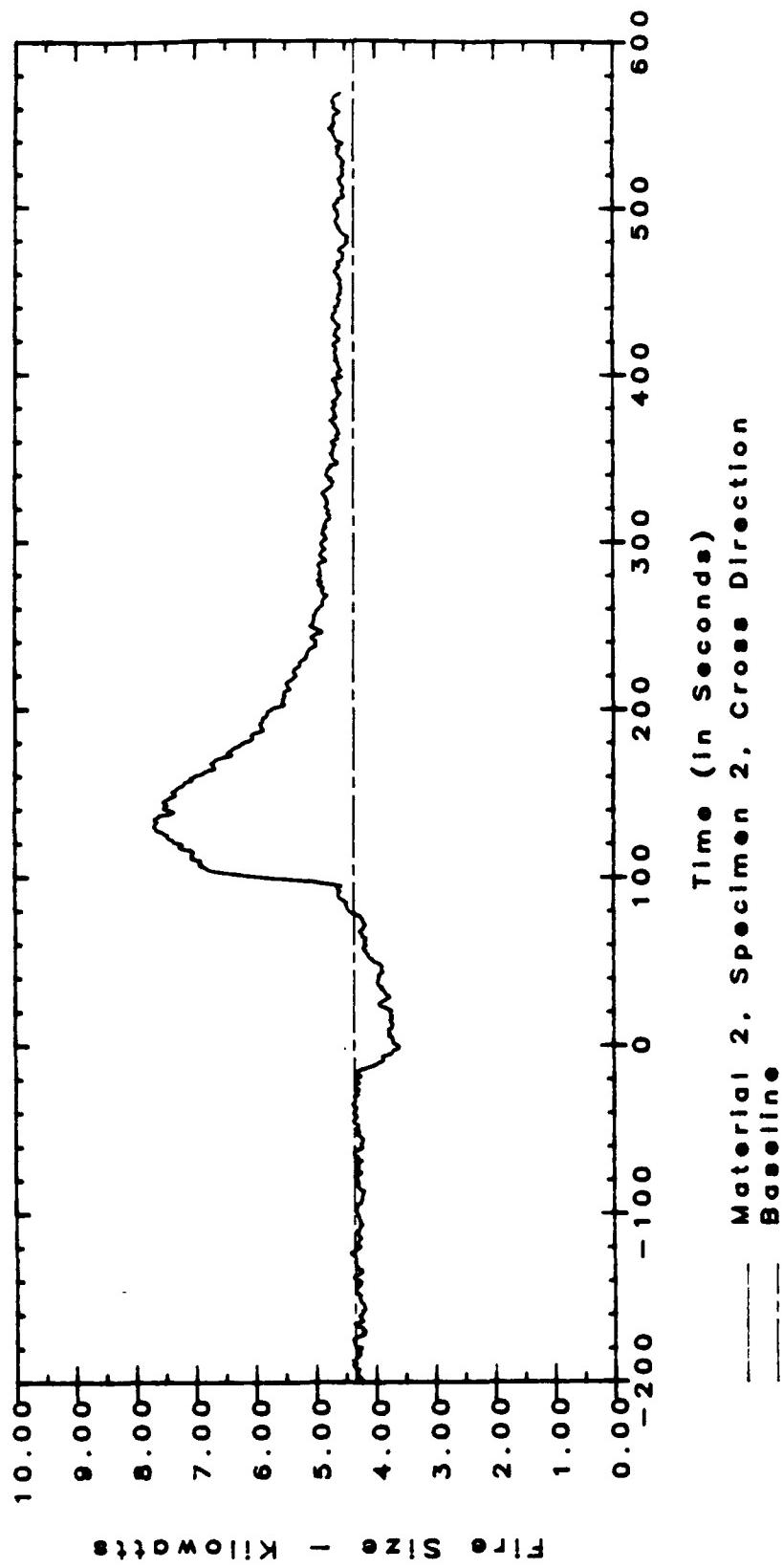
Time (sec)	Distance (mm)	Remarks
8		Pyrometer 3.86mv
20-27	100-200	Spontaneous explosions
33	250	Explosions, heavy smoke
38		Bubbles are charred
46	300	Explosions up to 300mm
54		Heavy smoke
60	up to 250	Complete black char
67		Pyrometer 3.79mv
90	350	Bubbles progressed to 350mm
95	300	Char line, moderate smoke
100	up to 150	Intermittent flames
105		Flames are getting heavier across surface
115		Pyrometer 3.84mv
120		Flames are going about 6" into the stack
127	up to 300	Flames progressed up to 300mm, across surface
145	0-100	Material is raised off surface along center line about 2"
153		Still have flaming, orange color
157	0-50	Flaming has ceased
167	50-200	Intermittent flames, light smoke
175	400	Black char line
195		Intermittent flames about 1" height off exploded material
200		Light smoke, pyrometer 3.93mv
230-240	150-250	Intermittent flames, material raised from specimen backing about 1 1/2", ready to fall
244		Piece just fell
253		Another piece fell
265	450	Intermittent flames at 450mm, above center line, 1/2" height
277-285	0-250	Material separated from specimen with some material falling off, turning white char
292		Pyrometer 3.94mv
310	250	Intermittent flames at 250mm, above center line about 2" height
322		No flame spread, material burning exploded pieces

TEST: M2CDS2SP2 Specimen Number 2 (cont'd)  
DATE: 21 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
335	400	Dark char line
340	400-425	Light char line
345	425-500	Surface bubbles above and below center line
353		Pyrometer 3.94mv, very light smoke
365		Intermittent flames have ceased
430	250	Intermittent flames up to 250mm, flickering on and off
445		Material that separated from specimen is burning white char, flames flickering
450		Pyrometer 3.98mv
490		Intermittent flames ceased
495		Pyrometer 3.97mv
505-520	0-200	Final appearance: Material separated from specimen below center line, no material above center line
527	200-400	Material raised off specimen about 1"
538	up to 450	Complete black char
545	475	Light brown char line
552	525	Surface bubbles above and below center line
560		Test secured

IMO FLAME SPREAD TEST



B-2.47

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TEST: M2CDS3SP2 Specimen Number 3

DATE: 27 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

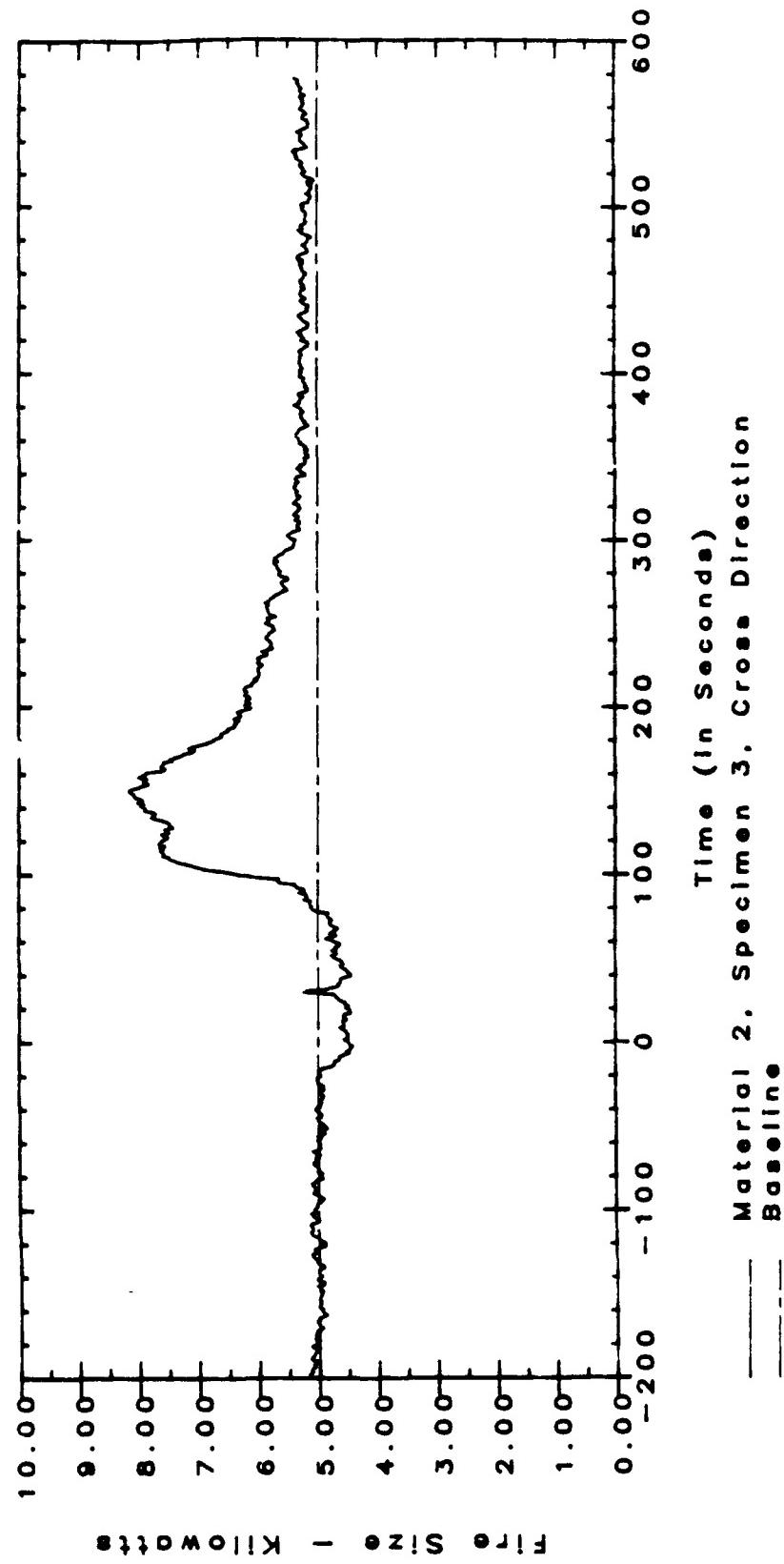
Time (sec)	Distance (mm)	Remarks
11		Pyrometer 3.80mv
25	100	Large bubbles formed 3" in dia.
32	200	Large bubble formed 2" in dia.
35-45	up to 250	Moderate smoke, delamination where bubbles had formed, complete char
48	300	Bubbles above and below center line
55	0-200	No material left on specimen where bubbles exploded
70		A piece of material that exploded is burning over pilot flame
80	350	Bubbles progressed above and below center line
85	300	Dark brown char line
90	350	Light brown char line
95-110	0-100	Light flaming 3" into stack, burning material that exploded earlier
115	150	Flames progressed
120		Pyrometer 3.85mv
128-140	up to 200	Moderate smoke, flames progressed to 200mm burning material that separated from specimen
147	400	Light brown char line
152	350	Dark brown char line
158	425	Bubbles above and below center line
170	0-100	Flames ceased
175-185	100-250	Flames across surface, 4" into stack, burning material that had separated from specimen
195		Pyrometer 3.95mv
210	0-200	Intermittent flames ceased
220	200-250	Intermittent flames 1" in height off surface
235	0-100	Material has fallen off specimen
250	0-250	Laminate raised off backing, still attached
300		All intermittent flames have ceased
310	0-150	No material left on specimen except for around the edges of sample holder
320-330	150-250	Material is raised off specimen backing about 2" but still attached to laminate

TEST: M2CDS3SP2 Specimen Number 3 (cont'd)  
DATE: 27 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
335	250-400	Dark brown char line
340	400-475	Light brown char line
345	500	Bubbles above and below center line
352		Light smoke, pyrometer 3.95mv
365	200-250	Intermittent flames
470		Intermittent flames have ceased, no smoke
485		Pyrometer 3.96mv
490-495	0-200	No material left on specimen except for around the edges of sample holder
500-510	200-300	Material has separated and raised off specimen about 2"
515	300-400	Material is alligatored
525	425	Dark brown char line
535	425-500	Light brown char line
555		Pyrometer 3.95mv, test secured

IMO FLAME SPREAD TEST



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TEST: M2CDS4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

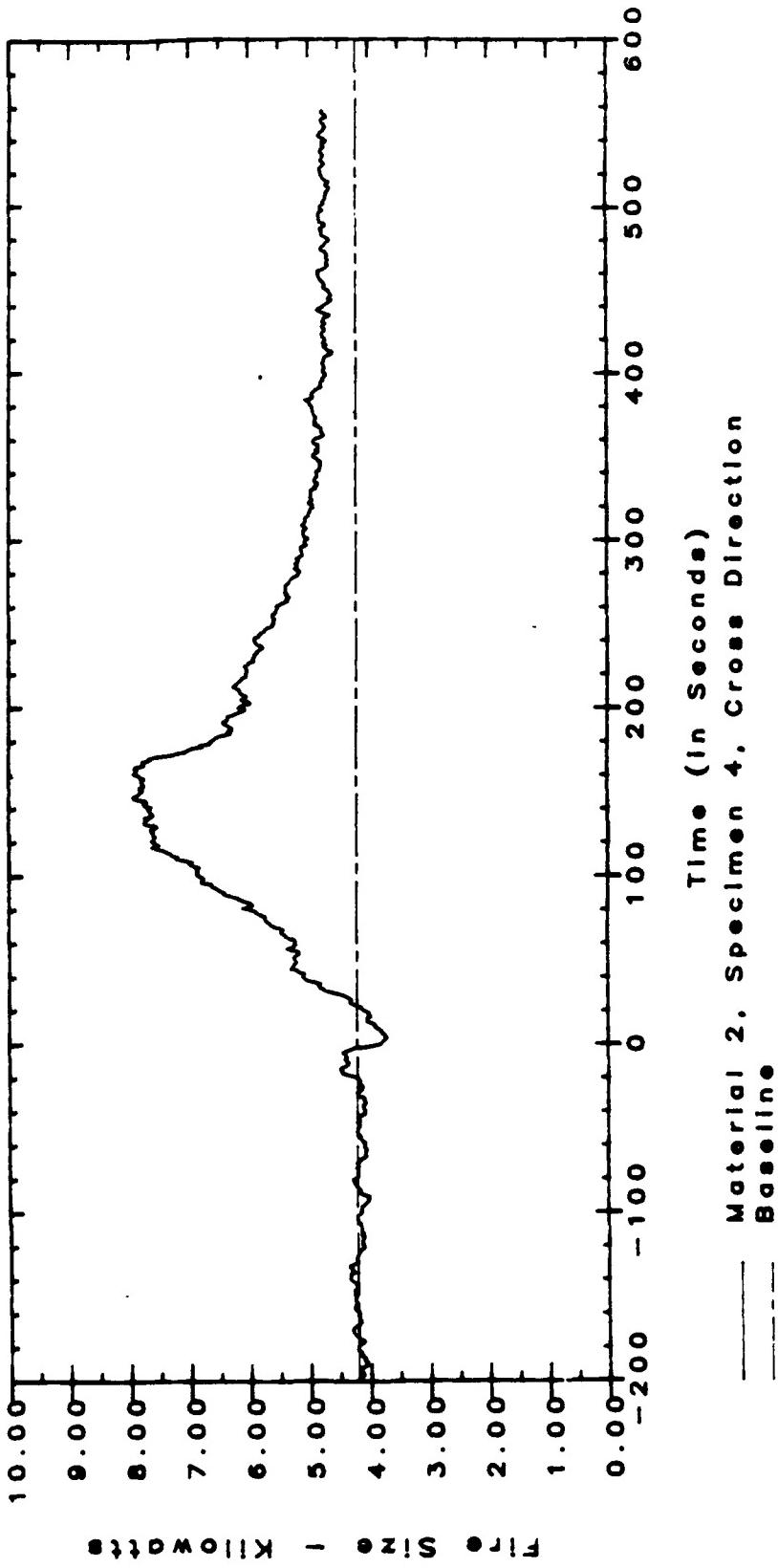
Time (sec)	Distance (mm)	Remarks
12	0-40	Spontaneous charring at impinging pilot
23	up to 200	Spontaneous bubbles.
30	200	Complete black char, heavy black smoke
37	250	Progression of bubbles, heavy black smoke
45		Heavy black smoke, no flames except at impinging pilot
55		Pyrometer 3.76mv
60	300	Progression of bubbles and black char, heavy smoke
90	50-100	Intermittent flames about 4" height into stack, above center line
105	0-100	Intermittent flames across specimen above and below center line
110	100-150	Intermittent flames
120	150	Flames about 5" height into stack, above and below center line
132	300	Progression of dark char line
135	400	Progression of bubbles and light char line
140		Pyrometer 3.86mv
160	200	Flames across specimen above and below center line, laminate separating from backing at pilot
175	50-200	Laminate is alligatored and separating from specimen backing
190	0-100	Intermittent flames have ceased
197-205	100-250	Intermittent flames above and below center line, decrease to 1" height into stack
215	350	Progression of dark brown char line
217	375	Progression of light brown char line
220	450	Bubbles across specimen above and below center line
235	250	Still have intermittent flames, flickering on and off, light smoke
240	200	Laminate separated from specimen backing and ready to fall off

TEST: M2CDS4SP2 Specimen Number 4 (cont'd)  
DATE: 29 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
262	0-200	Laminate has fallen off of specimen along the center line
273		Intermittent flames have ceased, light smoke
278		Pyrometer 3.94mv
300	0-200	Laminate continues to fall along center line
322	475	Bubbles across specimen, above and below center line
329	400	Dark brown char line
334	425	Light brown char line, light smoke
380	0-250	Laminate fallen off along center line
395	300	Intermittent flames on center line
415		Intermittent flames have ceased, light smoke
420		Pyrometer 3.95mv
460		Pyrometer 3.96mv, smoke has ceased, no flames
475	0-200	Laminate has fallen off specimen along the center line
485	200-300	No laminate on specimen except for along the bottom edge of specimen holder
505	300-350	Material alligated and raised off 1" from specimen backing
515	350-450	Complete dark brown char line
520	450-500	Complete light brown char line
527	450-525	Bubbles across specimen
535		Pyrometer 3.96mv, test complete

IMO FLAME SPREAD TEST



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B-2.56

TEST: M2CDS5SP2 Specimen Number 5

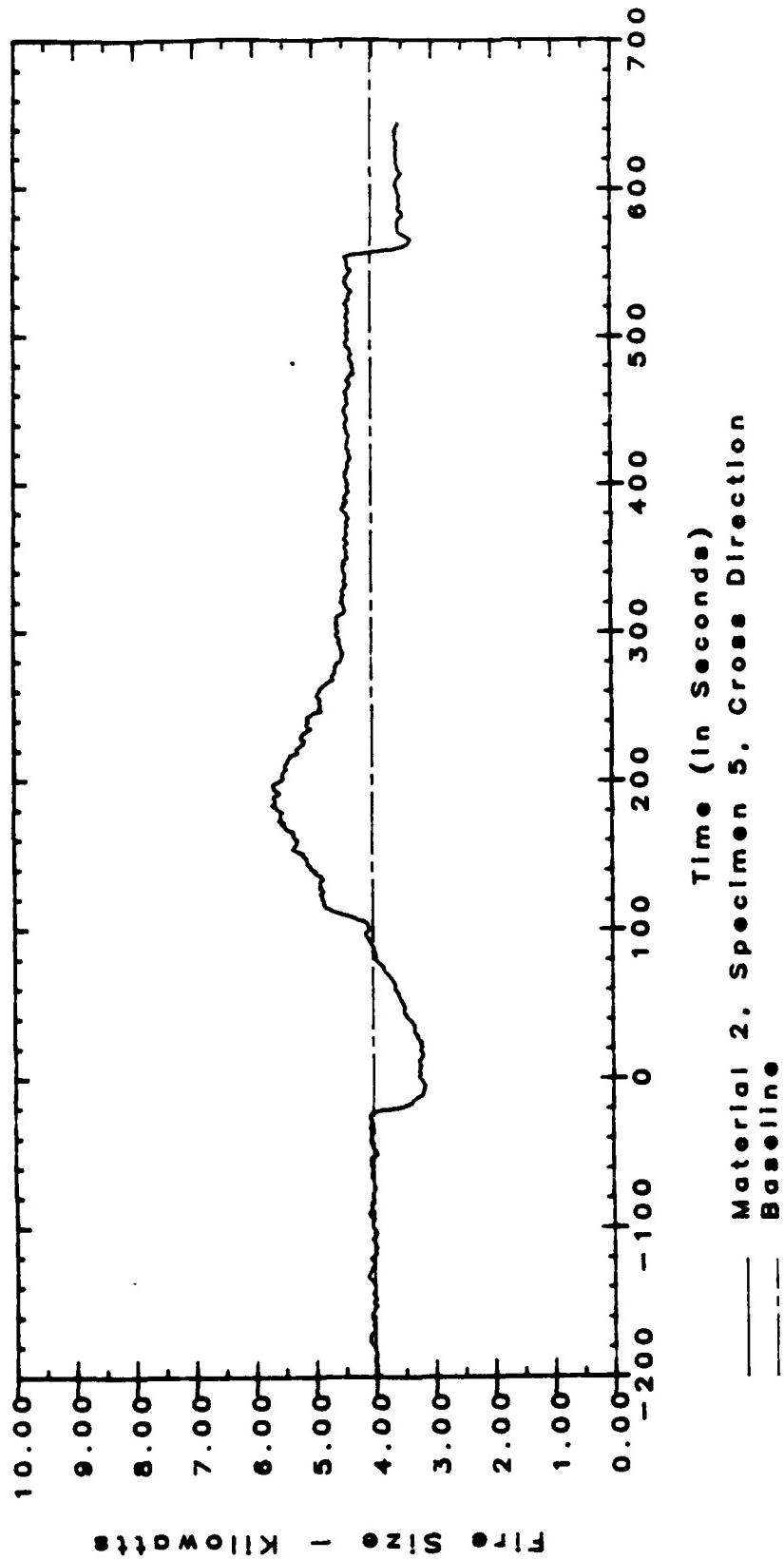
DATE: 30 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
18		Pyrometer 3.71mv
25	100-200	Loud explosion at 100mm, delaminated 150-200mm
35	250	250mm explosion, complete char, heavy black smoke
45	0-100	Material separated from backing
55	300	Progression of bubbles and char
90	350	Bubble above and below center line
100	300	Dark brown char line and alligated surface
108	350	Light brown char line
113	400	Bubble across surface above and below center line
115	0-100	Intermittent flames about 3" height
155	0-200	Flame across surface burning bubbles that had exploded during beginning of test
225	200	Material has separated and split from backing at this point
235	0-200	Material is raised off backing about 1" and turning to red char
245	200-300	Material is raised off backing about 1" with intermittent flames and material falling
470	300	All intermittent flames have ceased
480		Pyrometer 3.94mv
500	0-300	No material is left on specimen except along bottom edge of holder
515	300-400	Material is raised off backing, and alligated, turning to white char about 1"
525	400-425	Dark brown char line
530	425-475	Light brown char
540	475-500	Bubbles above and below center line
553		Pyrometer 3.95mv, test secured

IMO FLAME SPREAD TEST



B-2.58

TEST: M2MDS1SP2 Specimen Number 1  
 DATE: 20 July 1987  
 MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

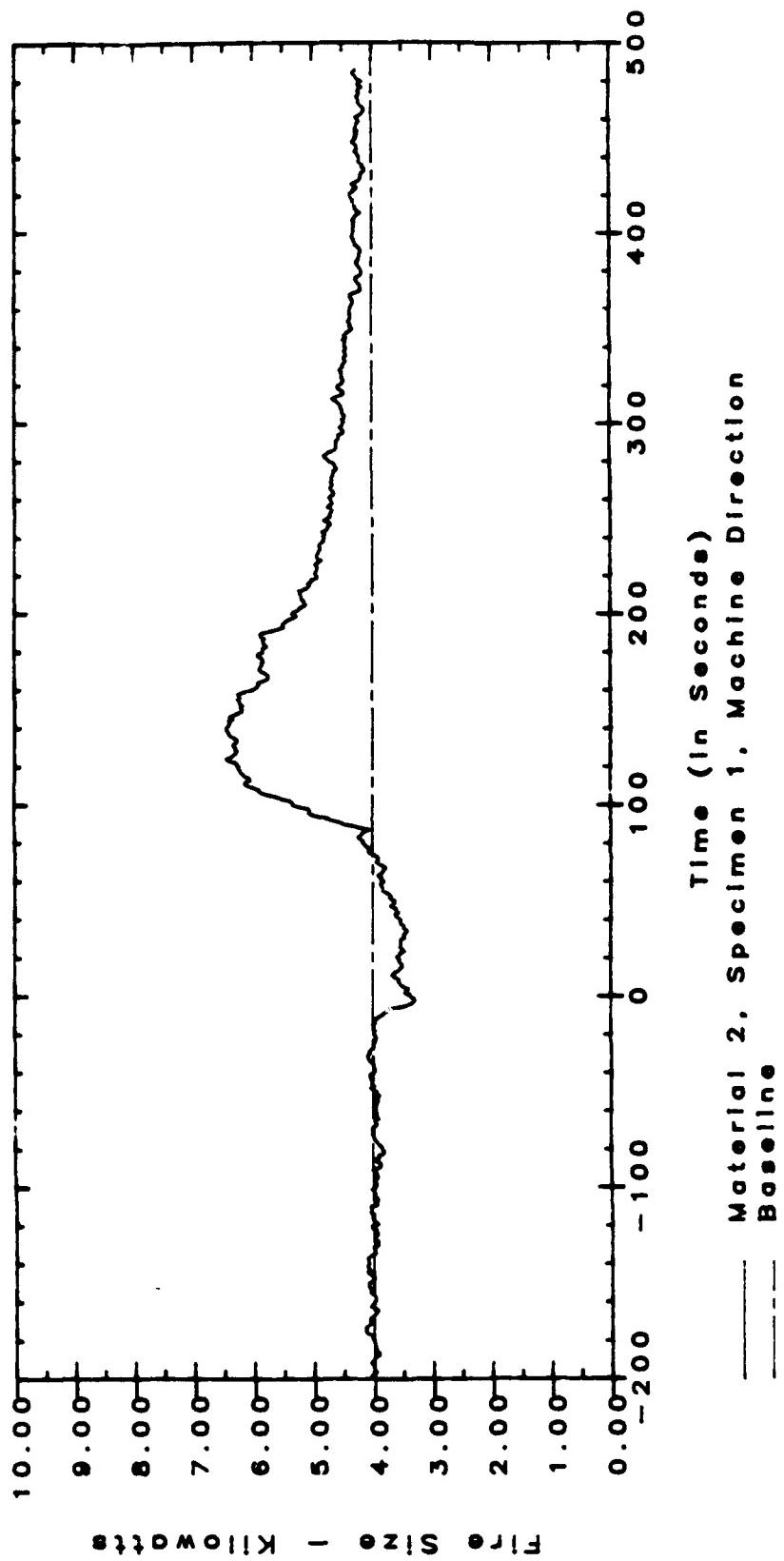
Time (sec)	Distance (mm)	Remarks
10 20-45	100-250	Pyrometer 3.79-3.80mv Spontaneous explosions and cracking at 100, 150, 250 and 250mm. Heavy smoke, material separating at explosion site, bubbled surface turns to brown char, then explodes
55	350	Bubbling, then charring
62	0-250	Black char, bubbles separating from specimen
68	350	Heavy black smoke, bubbles
75		Pyrometer 3.80mv
84		No flame, heavy black smoke
95 100-120	0-50 up to 100	Intermittent flames above centerline Intermittent flames above centerline up to 100mm, about 5" into stack, flames on material that exploded in the beginning of test
130	400	Intermittent flames, dark char
150		Flame orange color across face of specimen
160		Pyrometer 3.91mv
175	200-450	Still flaming up to 200mm, black char line 400mm, bubbles up to 450mm
190	150	Material is separating from specimen backing and falling off
202	100-250	Intermittent flames
212		Light flames and smoke above centerline, no flame spread
235	0-150	No flame
245	150-250	Intermittent flame above centerline, material has separated from original backing
262	400	Dark char line
265	400-450	Light char line
274	450-500	Bubbles on surface
277		Pyrometer 3.96mv
290	300-350	Intermittent flames above centerline, light flames and smoke
312		Flames still flickering
340		Pyrometer 3.98mv
357		Very light smoke, flame is out
370	0-200	Laminate material has separated from specimen and fallen off

TEST: M2MDS1SP2 Specimen Number 1 (cont'd)  
DATE: 20 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
377	200-300	Laminate material is separated and raised from backing
386	300-450	Dark brown char line
395	450-475	Light brown char line
402	475-525	Bubbles on surface
410		Pyrometer 3.97mv
427		No smoke or flames
435	0-250	Material has fallen off original backing
440	250-350	Material is raised off specimen, still attached
453	350-450	Dark brown char line
460	450-475	Light brown char line
470	450-500	Bubbles on surface

IMO FLAME SPREAD TEST



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B-2.62

TEST: M2MDS2SP2  
 DATE: 21 July 1987  
 MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

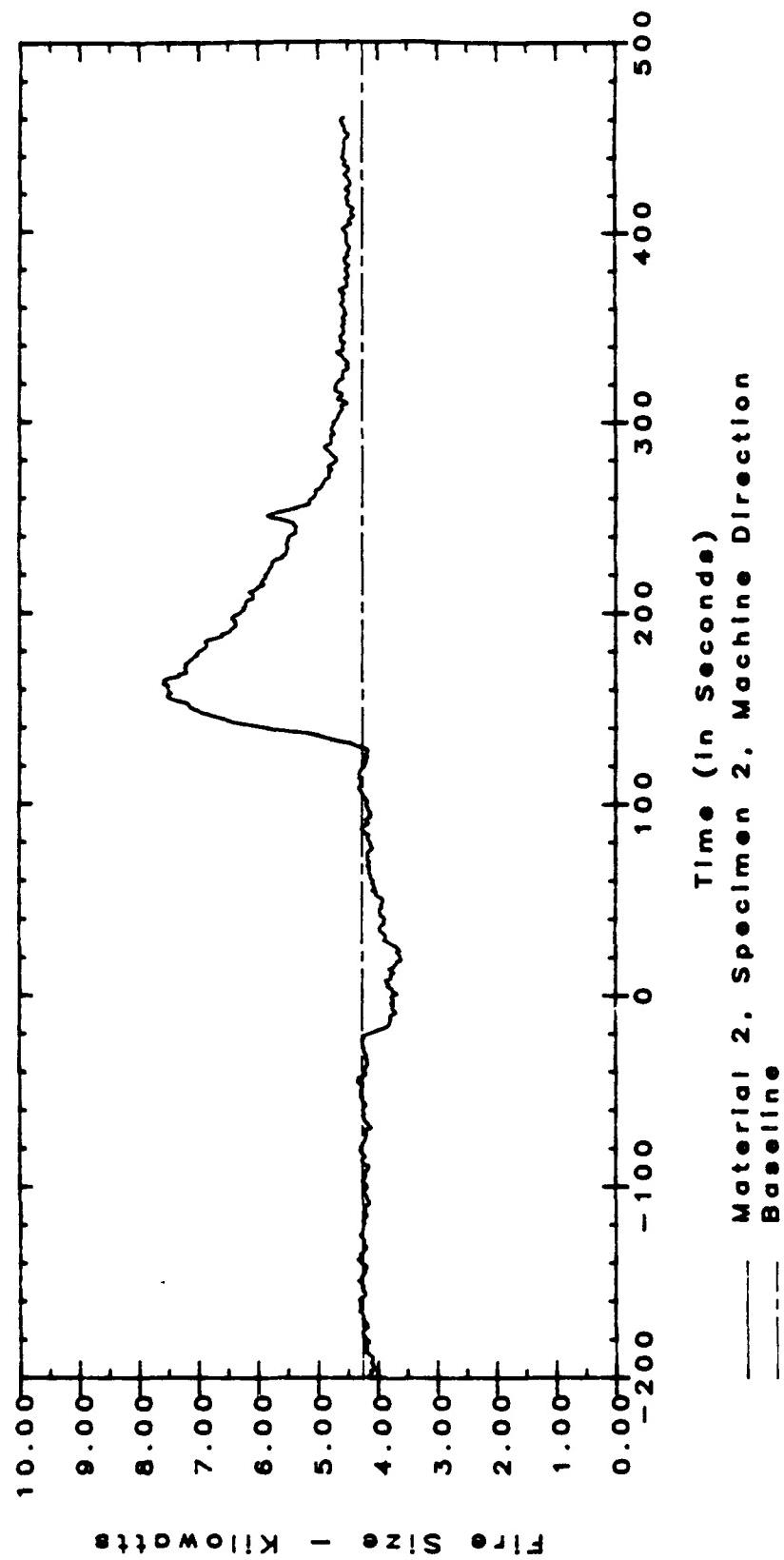
Time (sec)	Distance (mm)	Remarks
7		Pyrometer 3.86mv
20	up to 100	Spontaneous explosions about 2" in dia.
27	up to 200	Explosions, heavy smoke, and black char at 100mm
37	up to 250	Explosions, heavy smoke, black char
46		Pyrometer 3.76mv
55	up to 300	Bubbles, surface black with char
60	up to 250	Complete char across surface
65	250-300	Light brown char progressing rapidly
70-80		Moderate smoke, no flame
85	up to 350	Bubbles and char across surface
100-105	300	Moderate smoke, dark char line
110	300-375	Light brown char line
120	375-400	Bubbles on surface
125		Moderate smoke
135-150	150-200	Surface is alligated with intermittent flames 0-100mm, 150-200mm across the face of surface about 4" to 6" into stack, flame turning steady
155-180	up to 250	Pyrometer 3.87mv, flaming is burning loose material up to 250mm, across the face of surface, orange in color, not heavy light
205	up to 250	Flames turned to intermittent, light blue in color
220	0-200	Material separated from specimen and raised off backing about 1"
225		Still intermittent flames, light smoke
230	350-450	Dark char line, light brown char line to 450mm
240		Pyrometer 3.94mv
255	0-150	Large section fell off specimen
270	150-250	Material raised off specimen but still attached, small intermittent flames
280		Very light smoke
305		Pyrometer 3.94mv
315		Intermittent flames have ceased
320		Very light smoke

TEST: M2MDS2SP2 (cont'd)  
DATE: 21 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
385		Pyrometer 3.94mv
395	0-150	No material on specimen except around edges
403	150-250	Material is raised off specimen, still attached
413	250-400	Complete black char, surface alligatoring
423	400	Dark char line
430	400-475	Light brown char
438	475-525	Bubbles across the surface, above and below center line
445		No smoke, no progression
450		Pyrometer 3.96mv
455		Test complete

IMO FLAME SPREAD TEST



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TEST: M2MDS3SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

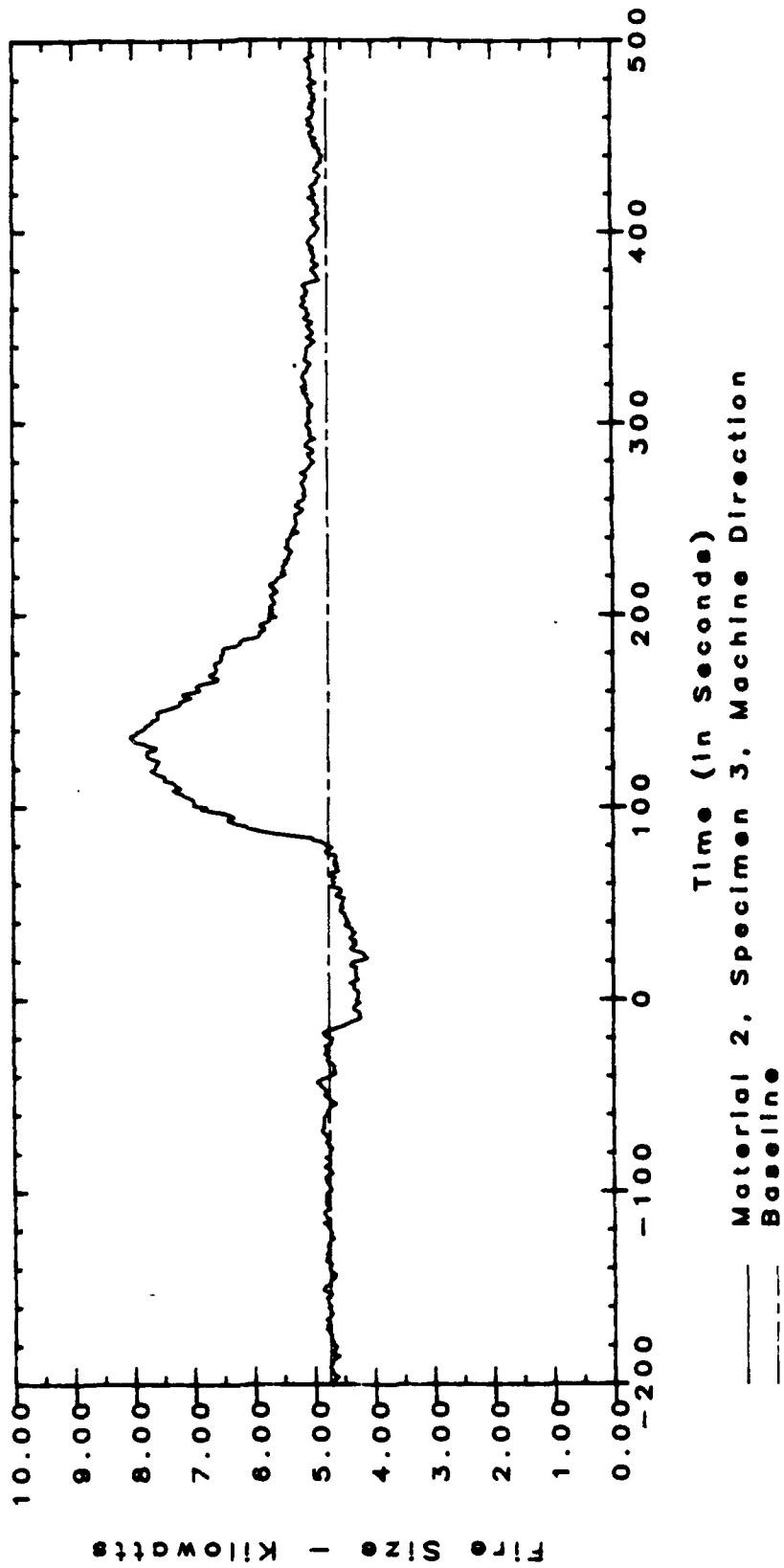
Time (sec)	Distance (mm)	Remarks
13		Pyrometer 3.78mv
20-25	up to 200	Spontaneous explosions
33	0-50	Surface char on top of bubbles, above center line
38	up to 300	Moderate to heavy smoke, bubbles
40-45	250	Surface char on top of bubbles across specimen
50		Heavy smoke, material has alligated
65		No flames, pyrometer 3.78mv
75-80	300	Heavy smoke, dark brown char line
85	300-350	Light brown char line
90	375	Bubbles across specimen above and below center line
92-100	0-100	Intermittent flames above and below center line 4" into stack
105-115	0-150	Heavy flames across the face of specimen, orange color, burning material from explosions
120		Moderate smoke, pyrometer 3.87mv
135	up to 200	Flames are still steady, slowly progressing
140-150	0-100	Material has raised off specimen and separated and burning
155	350	Dark brown char line
158	425	Light brown char line
162	425	Bubbles across specimen above and below center line
165	100	Piece of laminate just fell
175	100-250	Flames decreased to 2" height, intermittent now
195		Pyrometer 3.92mv
215		More laminate falling off
225	150-200	Intermittent flames ceased
235	200-250	Intermittent flames 1/2" off, on and off, light smoke
243	450	Light brown char line
247	475	Bubbles across specimen above and below center line
260-270	0-200	Material has fallen off of specimen, material around edges of specimen holder still intact

TEST: M2MDS3SP2 Specimen Number 3 (cont'd)  
DATE: 27 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
275		Intermittent flames have ceased
280		Pyrometer 3.91mv
285-294	200-300	Material has raised off backing 1" but still attached to specimen
299	300-400	Dark brown char line
305	400-475	Light brown char line
310	475-500	Bubble across specimen above and below center line
312		Very light smoke
324-340	0-200	Material at bottom of specimen holder turning to red and white char with intermittent surface flames
395		All intermittent flames have ceased
400		Pyrometer 3.94mv
410		No smoke, no flames, no progression
420-428	0-200	No material left on specimen except for around the edges of holder
430	200-300	Material is raised off specimen backing 1"
440	300-425	Complete dark char line
450	425-575	Complete light char line
457	510-575	Bubbles across specimen above and below center line
465		Pyrometer 3.96mv, test secured

IMO FLAME SPREAD TEST



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B-2.70

TEST: M2MDS4SP2 Specimen Number 4

DATE: 29 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
11	0-25	Spontaneous charring at impinging pilot
20		Pyrometer 3.74mv
22	200	Spontaneous explosion
30	200	Spontaneous charring on top of bubbles
40	250	Progression of bubbles exploding, heavy smoke
55	300	Progression of bubbles and black char, heavy smoke
85	100	Intermittent flames above center line
110	0-150	Intermittent flames across specimen 4" height into stack
120	0-200	Specimen surface is alligated
127	400	Progression of char line and bubbles
132		Flames are steady now and very light, pyrometer 3.86mv
155	200	Progression of flames across specimen
162-180	0-25	Laminate has separated from specimen backing, spontaneous now up to 150mm raising off specimen backing about 1"
185	0-50	Intermittent flames have ceased
192	50-200	Steady flames and very light 3" height into stack
202	425	Progression of black char line
207	450	Bubbles across specimen above and below center line
227	150	Intermittent flames have ceased
234	150-200	Intermittent flames are on and off 1/2" height
245	50-150	Laminate is separating and splitting along the center line with a piece falling off at 50mm and 150mm
265		Intermittent flames have ceased, light smoke
275	150-250	Alligated across surface
290		Pyrometer 3.92mv

TEST: M2MDS4SP2 Specimen Number 4 (cont'd)

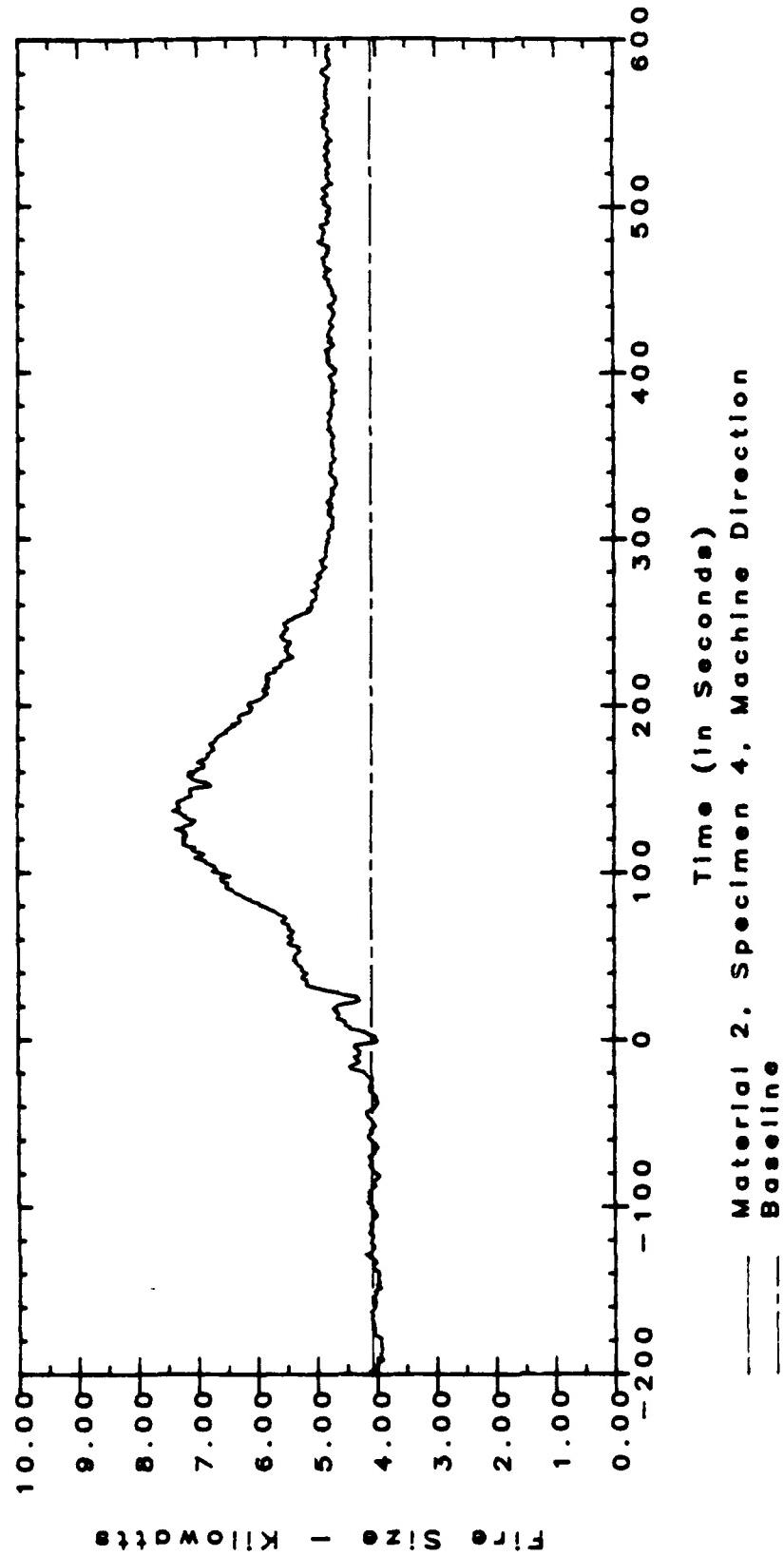
DATE: 29 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
320	250	Intermittent flames 1/2" height, light color on center line, light smoke
410		Intermittent flames are out, very light smoke
423		Pyrometer 3.97mv
440	0-100	0-100mm of laminate left on specimen surface except for around the edges of specimen holder
455	100-150	Material separated from specimen, no material left on center line
465	150-200	No material left on specimen, except below center line along specimen holder
480	250-300	Laminate is raised off specimen backing about 1"
500	300-450	Complete dark brown char line
505	450-500	Complete light brown char line
513	400-500	Bubbles across the specimen above and below center line
517	0-200	Intermittent flames that are flickering on and off 1/2" height on separated material, light smoke, material is still attached to specimen
567		Intermittent flames have ceased
575		No further change to specimen appearance
580		Pyrometer 3.98mv, test complete

IMO FLAME SPREAD TEST



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B-2.74

TEST: M2MDS5SP2 Specimen Number 5  
 DATE: 30 July 1987  
 MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
20	0-100	Spontaneous explosion, large section
28	150-200	Explosions
39	0-100	Large section is black char
42	250	Complete black char
48	300	Bubbles above and below center line
52		Moderate smoke
62		Pyrometer 3.73mv
78	200	Heavy smoke
87	300	Complete black char
90	350	Bubbles and complete light brown char
100	0-100	Material has separated from backing
120	0-100	Intermittent flames across specimen burning the separated material
155	200	Progression of flames about 3" into stack, material is turning red and alligatored
172		Light smoke
192	200	Flames are decreasing about 1" off surface
225	0-100	Intermittent flames have ceased
235	100-250	Intermittent flames across specimen about 1" off surface
245	0-250	Material is white with char, raised off backing about 1" but still attached to sample
262	400	Light smoke, complete dark char line
267	400-475	Light brown char line and bubbles, pyrometer 3.93mv
305		Still have intermittent flames, flames, as well as material, are falling off sample
325	250	Intermittent flames have ceased
335	50-100	Intermittent flames on material that had separated from backing leaned toward panel
350	0-200	No material left on specimen except for around edges of holder
405		All intermittent flames have ceased
410		Pyrometer 3.93mv

TEST: M2MDS5SP2 Specimen Number 5 (cont'd)

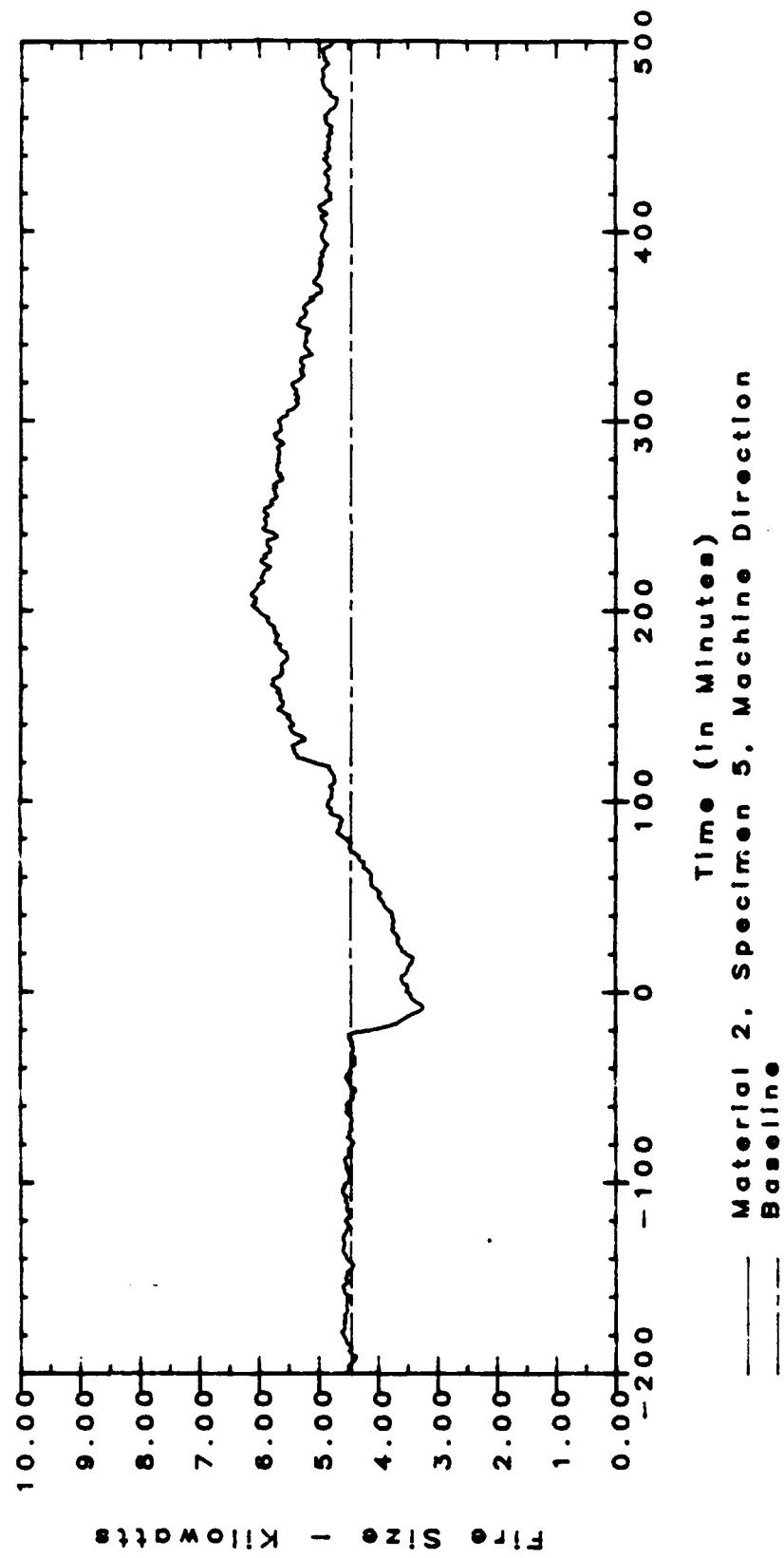
DATE: 30 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
455		Pyrometer 3.93mv, all activities have ceased
465	0-200	No material left on specimen except for around edges of holder
475	200-300	Material is raised off backing 1", still attached, complete black char and alligated
485	400	Complete black char
490	475	Complete light char
495	475	Bubbles across specimen
505		Pyrometer 3.94mv, test complete

IMO FLAME SPREAD TEST



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B-2.78

TEST: M3CDS1SP2 Specimen Number 1  
DATE: 20 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7		Pyrometer 3.89mv
18	100-200	Spontaneous explosions and cracking at 100, 150, 200mm
23		Heavy black smoke, black char on top of bubbles
25-42	250	Explosions and bubbles with dark charring on top of bubbles, heavy smoke, bubbles at 300mm, no flame
45-57	0-50	Intermittent flames above centerline burning material that exploded and separated from specimen at beginning of test
60-70	150	Flames up to 150mm, steady across the surface burning exploded material, no flame spread
80	350	Black char up to 350mm, bubbles up to 400mm
85		Pyrometer 3.85mv
95	0-100	Material completely separated from backing and flaking off
105-115	100-200	Laminate raised off backing with intermittent flames above centerline
125	400-450	Dark char at 400mm, bubbles at 450mm
134	200-250	Intermittent flames on centerline, 1" in height, material separating and raised off backing
150		Very light smoke
170		Pyrometer 3.92mv
180		Flame is out, very light smoke
197	400-500	Dark char line 400mm, light char line 450mm, bubbles up to 500mm
218	0-250	Material has separated and specimen is flaking
225	250-300	Material is raised off backing but still attached to specimen
233	300-450	Black char, material has not separated from backing, very light smoke, bubbles up to 500mm
248		Pyrometer 3.93mv
308		Pyrometer 3.92mv, no further progression

TEST: M3CDS1SP2 Specimen Number 1 (cont'd)

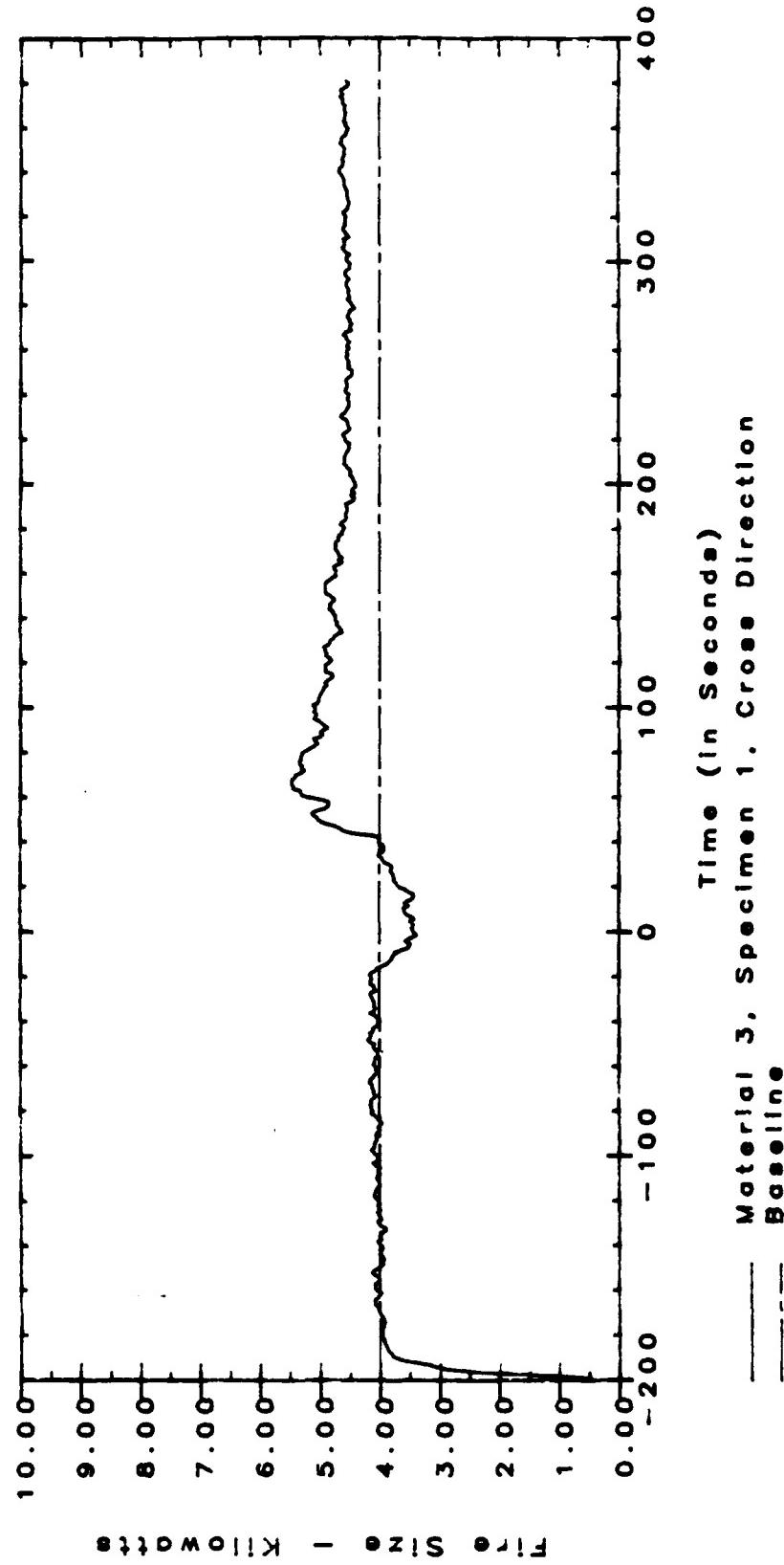
DATE: 20 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
318	0-250	Final appearance: Material separated from backing and fallen off specimen
332	250-300	Material raised off specimen, not falling off
342	300-450	Dark char line
346	450-475	Light char line
355	525	Bubbles on surface
365		No smoke, no flames, no flame spread

IMO FLAME SPREAD TEST



B-2.81

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B-2.82

TEST: M3CDS2SP2 Specimen Number 2

DATE: 21 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10		Pyrometer 3.76mv
15-25	50-150	Spontaneous explosion at 50, 100, 150mm, heavy black smoke, surface char
30	up to 250	Explosions
35-45	250-300	Heavy black smoke, complete surface charred, surface is alligatoring
50	0-100	Intermittent flames 4" into stack
55		Pyrometer 3.81mv
65-70	up to 150	Moderate smoke, flames progressed to 150mm across the face of material
80		Material starting to separate and raise off specimen backing about 2"
85	300	Dark char line
90	375-400	Light char line 375mm, bubbles up to 400mm
95	200	Intermittent flames decreased in size 2"
100-110	200	Light smoke, material has completely separated from specimen backing
115		Intermittent flames above center line
120		Pyrometer 3.86mv
130		Intermittent flames have ceased, light smoke
135	350	Dark char line
140	425	Light char line
145	up to 450	Bubbles on surface, light smoke
160	0-200	Material has separated and fallen off specimen backing
175	200-250	Material is raised off backing about 1", still attached to specimen
185	250-400	Dark black char
190	400-450	Light brown char
195	450-475	Bubbles above and below center line
200		Light smoke, no flame, no flame spread
205		Pyrometer 3.88mv
265		No further progression
280		Pyrometer 3.90mv

TEST: M3CDS2SP2 Specimen Number 2 (cont'd)

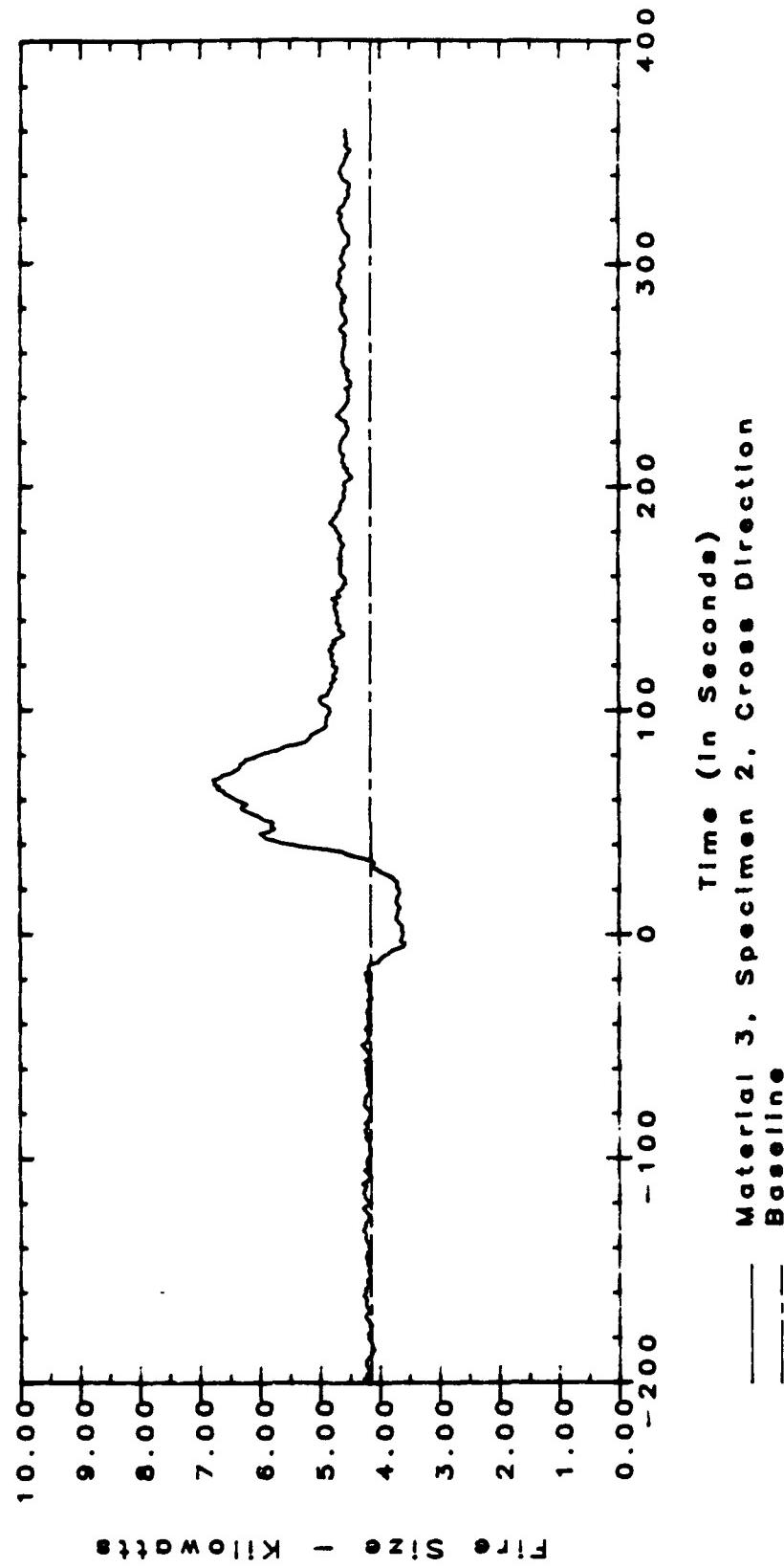
DATE: 21 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
295	0-250	Laminate has separated and fallen off specimen
305	250-350	Material has delaminated from specimen but still attached, raised off surface about 1"
325	350-400	Complete black char (dark)
330	400-475	Complete brown char (light)
340	475-500	Bubbles on surface above and below center line
345		No flames, no smoke
350		Pyrometer 3.91mv

IMO FLAME SPREAD TEST



B-2.85

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TEST: M3CDS3SP2 Specimen Number 3

DATE: 27 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
15		Pyrometer 3.80mv
20-30	up to 250	Spontaneous explosions at 200mm, large bubble from 0-50mm, charring, heavy smoke, complete char at 250mm
38	300	Bubbles across surface, heavy smoke
45	0-100	Laminate separating and alligatoring
48-58	0-100	Heavy smoke, intermittent flames burning separated materials
60	350	Bubbles across surface above and be- low center line
63	350	Char line
65-75		Flames reaching 4" into stack, moderate smoke still burning separated material at beginning
80		Pyrometer 3.88mv
90		Intermittent flames are decreasing to 2" height
95-105	0-100	No flame, material has completely separated from specimen
110-120	100-200	Intermittent surface flames, material is splitting down the center line and separating from specimen backing, flame height 2" off surface
125	400	Char line
130	425	Bubbles above and below center line, light smoke
135		Intermittent flames have ceased
145-155	0-100	Specimen turning white char, material is separated and raised off backing 3" leaning toward radiant panel
165		Pyrometer 3.92mv
180		No flame spread, no flames, light smoke
248		Pyrometer 3.93mv
260		No flame spread, no flames, very light smoke

TEST: M3CDS3SP2 Specimen Number 3 (cont'd)

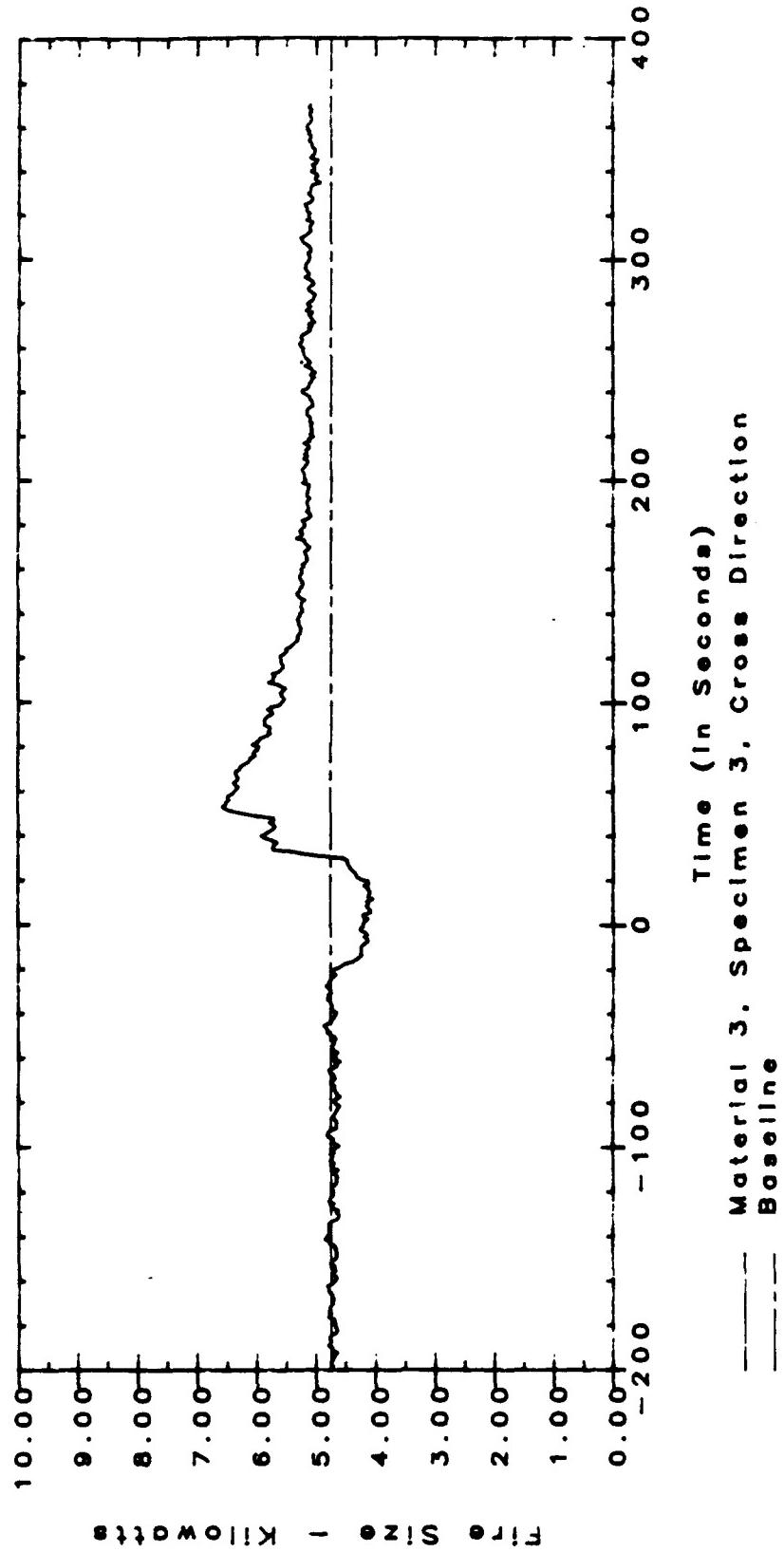
DATE: 27 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
265-275		Material has split down center line of specimen, separated, and raised off backing
285		Pyrometer 3.95mv
300-315	0-300	Material has split along center line of specimen, separated and raised off backing, some has flaked off specimen, material turning to white char
320-330	300-375	Material has split along center line of specimen, separated and raised off backing about 1/2" but still attached to laminate
335	400	Dark brown char line
340	400-475	Light brown char line
345	475-500	Bubbles above and below center line
360		Pyrometer 3.95mv, very little smoke

IMO FLAME SPREAD TEST



B-2.89

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B-2.90

TEST: M3CDS4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10	0-25	Spontaneous charring at impinging pilot
18	100-200	Spontaneous explosions
25	200	Specimen completely charred
27	250	Progression of bubbles across specimen
30	250	Progression of char line, heavy black smoke
40	300	Progression of bubbles across specimen
41-48		Air blowing from behind bubbles energizing smoke turbulence
50	300	Progression of char line, heavy black smoke
52	0-50	Laminate has separated from specimen backing
65	0-150	Flames across specimen about 4" height into stack
75-85	0-150	Laminate has separated from specimen backing with split along the center line, material leaning toward radiant panel, about 2" off specimen backing
90	0-50	Intermittent flames have ceased
95	50-200	Flames have decreased to about 2" height
100	100	Intermittent flames have ceased
115	150	Intermittent flames have ceased
120	150-200	Intermittent flames along center line, very light flame and smoke
128	450	Progression of bubbles across specimen
132	400	Progression of black char line
145	0-300	Laminate has separated from specimen backing and leaning toward radiant panel
152		Pyrometer 3.90mv
175		Intermittent flames have ceased, very light smoke
185	0-300	Laminate material has separated and curling toward radiant panel

TEST: M3CDS4SP2 Specimen Number 4 (cont'd)

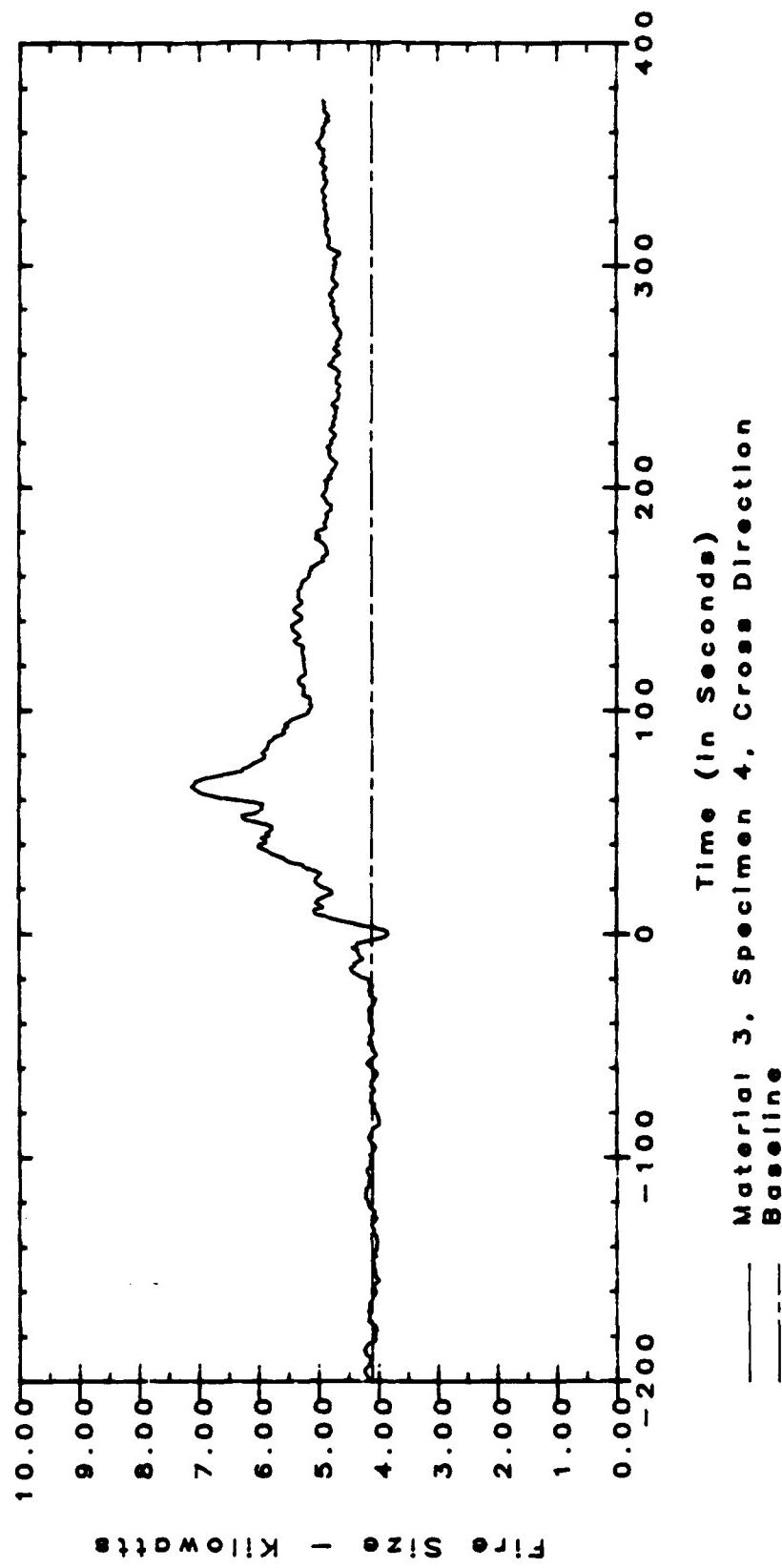
DATE: 29 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
190	400	Complete black char across specimen
198	400-450	Light brown char line across specimen
205	460	Bubbles across specimen above and below center line
290		Pyrometer 3.90mv, all smoke has ceased
300	0-300	Laminate material has separated from backing and curled toward radiant panel, 2" off backing
315	300-400	Laminate material has separated and raised off specimen backing about 1"
330	400	Complete dark brown char line
340	400-475	Complete light char line
347	400-500	Bubbles across specimen above and below center line
355		Pyrometer 3.93mv, test complete

IMO FLAME SPREAD TEST



B-2.93

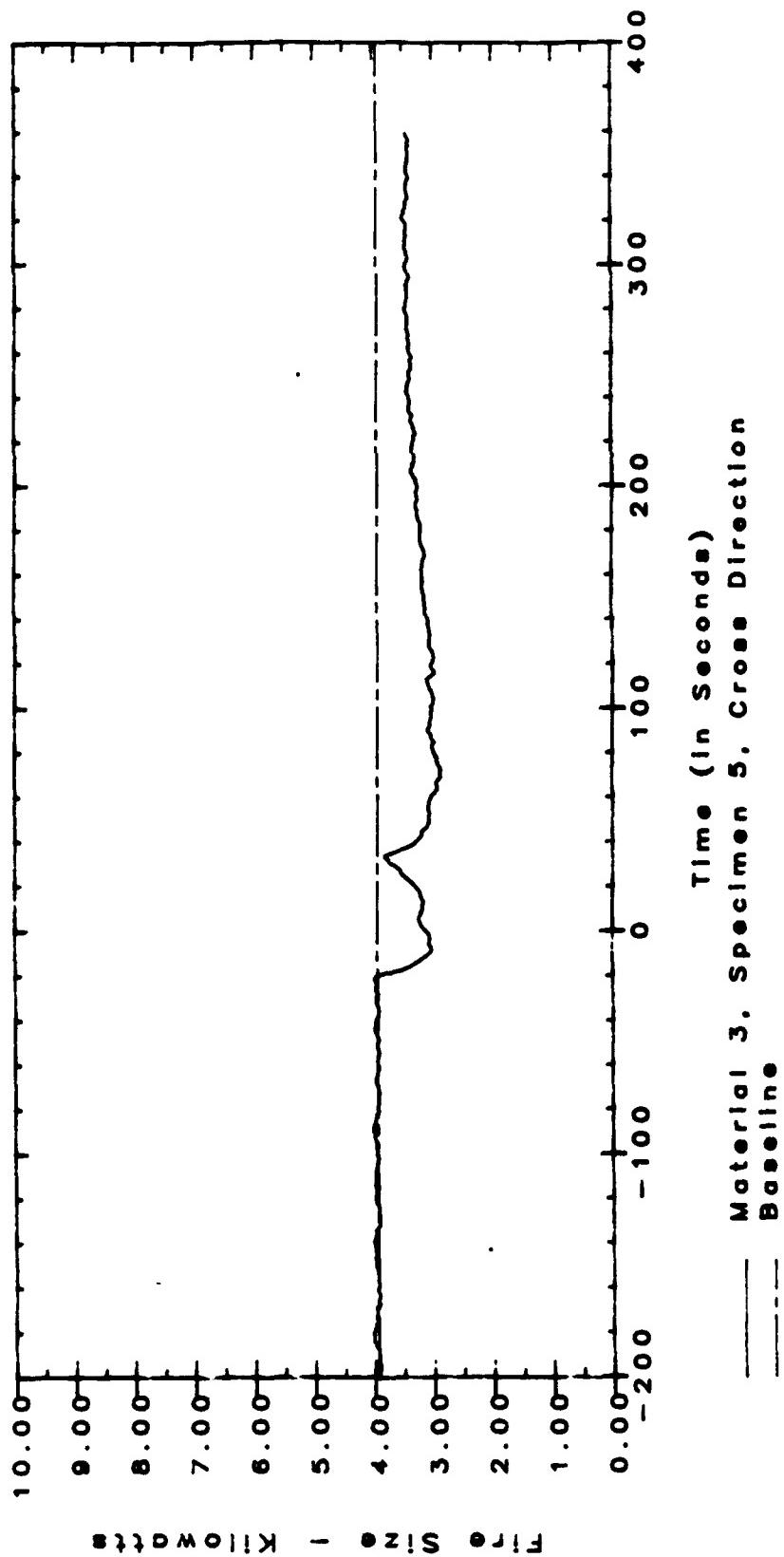
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TEST: M3CDS5SP2 Specimen Number 5  
DATE: 30 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
15	50	Loud explosion above center line
20	up to 250	Spontaneous explosions
45-50	250	Black char and black smoke
55		Horizontal pilot flame is out from smoke or explosions, secured fuel gas
95-110	0-250	Material has split along center line, has separated from backing and is leaning toward radiant panel, moderate smoke
115	350	Complete black char line
120	425	Light brown char line
128	450	Bubble above and below center line
135		Pyrometer 3.78mv
245	0-200	Intermittent flames above center line on top of separated material which is ready to fall off
250		Intermittent flames have ceased
285		Pyrometer 3.86mv, no further activities
300-315	0-250	Material has separated from specimen and is leaning toward radiant panel about 2-3". No material on center of sample
325	250-400	Complete dark char line
330	400-475	Complete light char line
342	425-475	Bubbles above and below center line
350		Pyrometer 3.88mv, test complete

IMO FLAME SPREAD TEST



TEST: M3MDS1SP2 Specimen Number 1  
DATE: 20 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

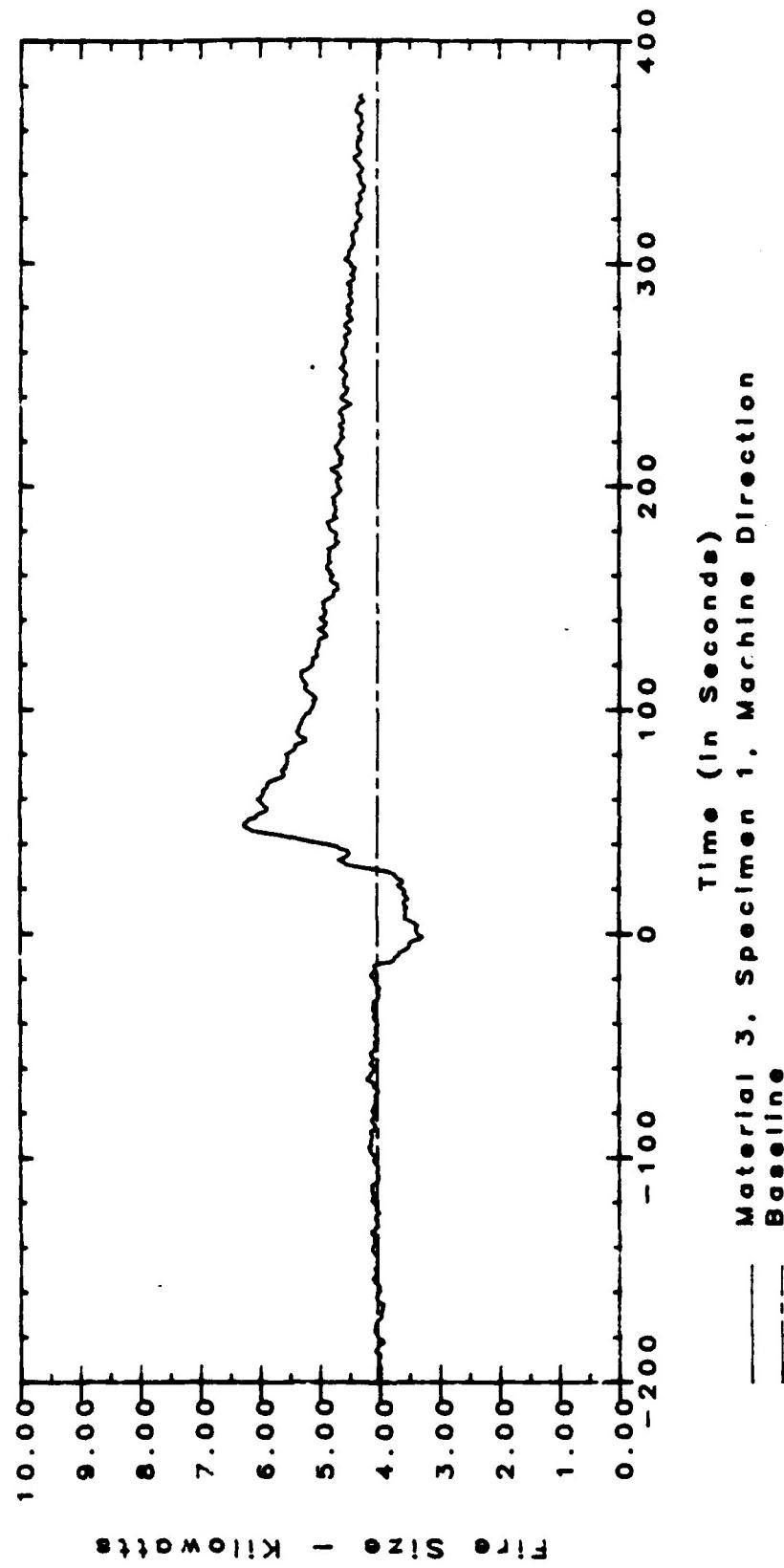
Time (sec)	Distance (mm)	Remarks
8		Pyrometer 3.85mv
17	100-200	Spontaneous explosions and cracking at 100, 150, 200mm
23	250	Heavy black smoke, black char on top of bubbles
33	0-50	Intermittent flames and heavy black smoke
40	300	Bubbles and surface delamination
45	150	Heavy black smoke, flaming up to 150mm above centerline
52	350	Flames about 4" into stack, bubbles up to 350mm
60-70		Flames at centerline, material separating from specimen
85	150	Flame ceased
90-100	0-150	Intermittent flames on material that has separated from specimen and is flaking off
105		Pyrometer 3.88mv
120-135	150-200	Intermittent flames across the face of specimen, alligated and separated from specimen
140	400-450	Char line 400mm, bubbles 450mm
150		Very light smoke
165-185	250	Intermittent flames about 1" in height at 250mm, about 25mm in length, material is raised off specimen backing about 2"
190	0-200	Material has separated and fallen off specimen
197	200-250	Material raised from specimen, still attached
207		No flame, very light smoke
214	450-475	Char line 450mm, bubbles 475mm
220		Light smoke, pyrometer 3.92mv
232		No flames, very light smoke
277		No activities, pyrometer 3.93mv
305	0-300	Material has separated and fallen off specimen
310	300-350	Material is raised from specimen but still attached
320	350-450	Dark char line
327	450-475	Light char line

TEST: M3MDS1SP2 Specimen Number 1 (cont'd)  
DATE: 20 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
335	500	Bubbles on surface
340		No smoke, no flames, no flame spread
360		Pyrometer 3.91mv

IMO FLAME SPREAD TEST



B-2.99

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TEST: M3MDS2SP2 Specimen Number 2

DATE: 21 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

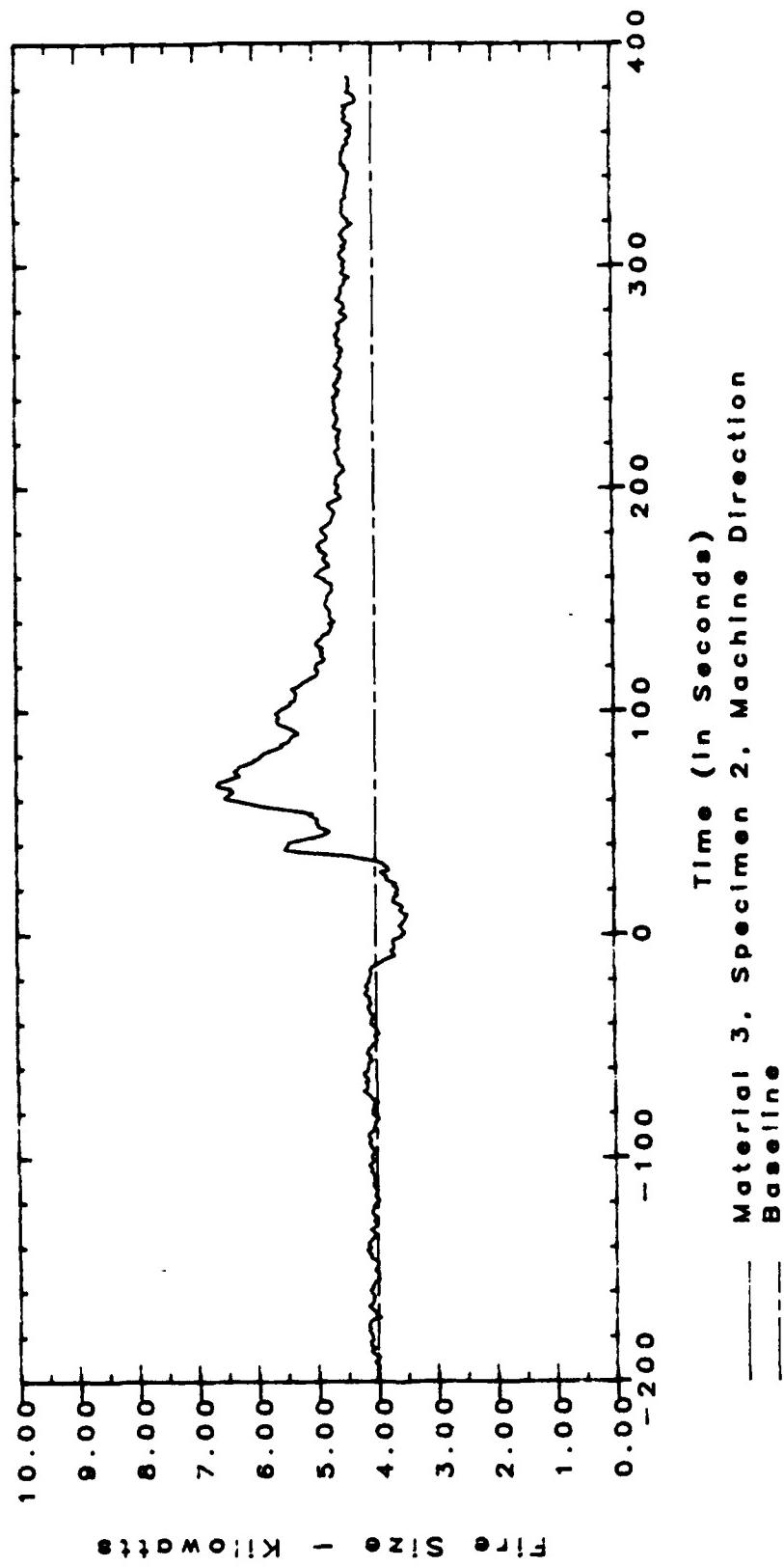
Time (sec)	Distance (mm)	Remarks
10		Pyrometer 3.77mv
18-30	100-200	Spontaneous explosion and delamination up to 100, 150, 200mm, black char on top of exploded bubbles, explosion up to 250mm, heavy black smoke
40-47	0-50	Intermittent flames above center line, heavy black smoke
50	up to 300	Dark char line
53	up to 350	Bubbles
55	0-50	Material flaking off backing
60	up to 100	Intermittent flames progressed up to 100mm above center line, flames reaching 6" into stack
65		Pyrometer 3.82mv
72-85	100-150	Material is separating from specimen at 100mm, flames progress to 150mm and decreased 2" height
90	200	Moderate smoke, material flaking off
105	150-200	Light intermittent flames above center line
110	350	Light smoke, dark brown char line
115	400	Light brown char line
120	425	Bubbles above and below center
135	250	Intermittent flames are out
145		Light smoke, material separating from specimen
155		Pyrometer 3.88mv
170	250	Intermittent flames at center line
175		Very light smoke, material separating at center line and flaking off
188		Intermittent flames are out
193		Very light smoke
200	150	Material turning white, char along edges of specimen
210	400	Dark char line
215	450	Light char line
220	450-475	Surface bubbles above and below center line
225		Pyrometer 3.90mv
230		Very little smoke

TEST: M3MDS2SP2 Specimen Number 2 (cont'd)  
DATE: 21 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
285		Final appearance, pyrometer 3.90mv
300	0-200	Material falling off specimen backing
305-315	200-300	Material hanging from specimen above center line, separated from backing about 2"
320-330	200-300	Material raised off backing, still attached at center line
345	300-400	Complete dark char line
350	400-475	Light brown char line
355	475-500	Bubbles above and below center line
370		No smoke, no flame
375		Pyrometer 3.90mv

IMO FLAME SPREAD TEST



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TEST: M3MDS3SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
15		Pyrometer 3.80mv
18-27	150-250	Spontaneous explosions to 150mm, black char on top of exploded bubbles up to 250mm, heavy black smoke
33	250	Black char line
36	300	Bubbles across surface above and below center line
40		Heavy black smoke
45	0-100	Intermittent flames
55	350	Bubbles across surface, heavy black smoke
60		Pyrometer 3.84mv
65-75	0-150	Complete flames across surface going about 4" into stack, burning material that separated
80		Intermittent flames decreasing
90-98	0-150	Laminate material has completely separated from specimen backing, flaking off
102	0-150	Flames have ceased
105	150-200	Intermittent flames about 1" off surface
115	350	Dark char line, light smoke
125	410	Light char line
130	450	Bubbles across surface, above and below center line
135	200	Intermittent flames have ceased, very light smoke
142		Pyrometer 3.88mv
220		Pyrometer 3.90mv
230		No progression, no flames, no flame spread, no smoke
240-250	0-250	Material has separated from specimen backing, leaning toward radiant panel, ready to fall
253-265	250-350	Laminate material is raised off backing but still attached to specimen about 1"
270	400	Dark brown char line
275	400-475	Light brown char line
283	475-500	Bubbles above and below center line

TEST: M3MDS3SP2 Specimen Number 3 (cont'd)

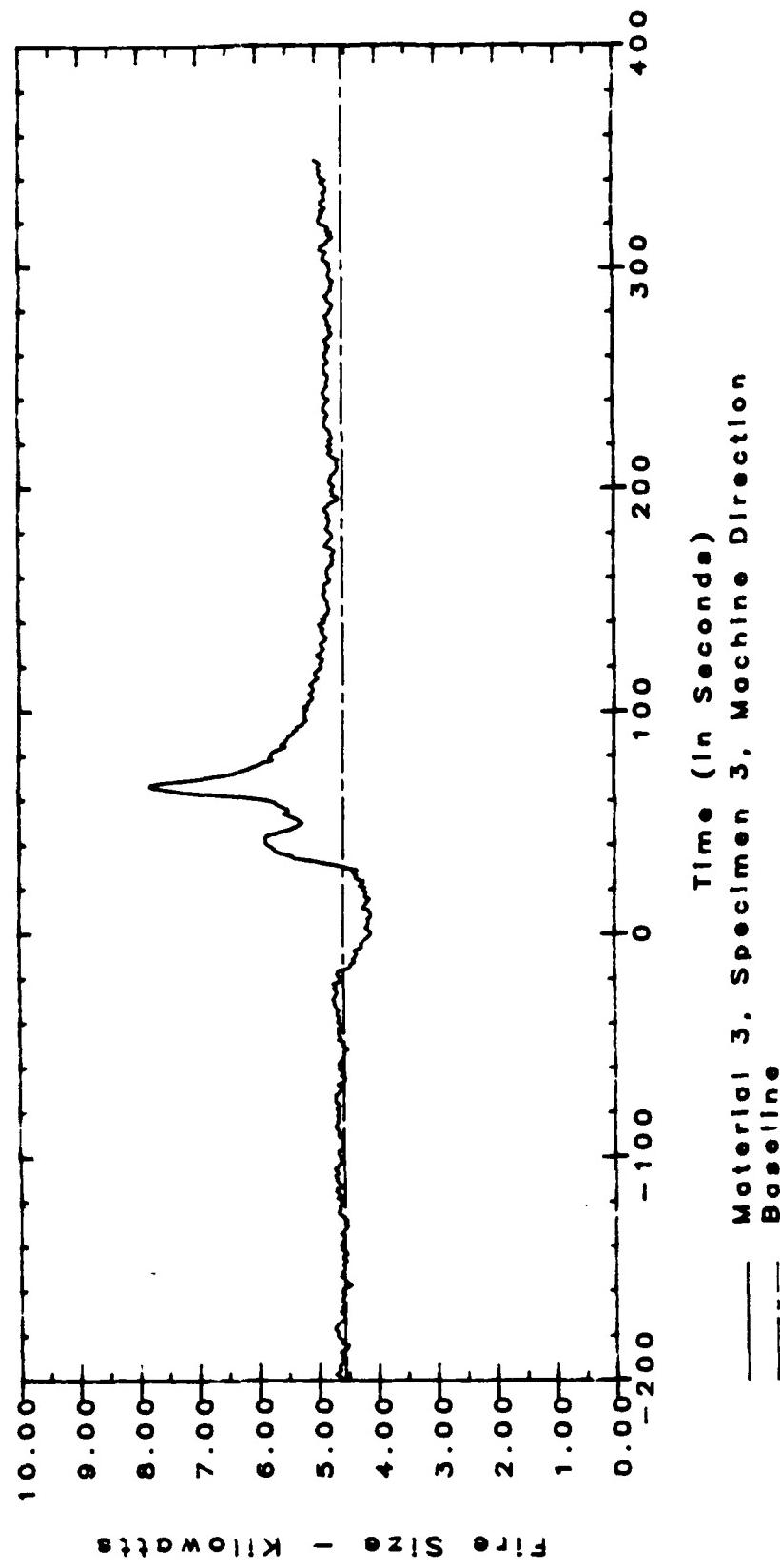
DATE: 27 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
290	0-50	Material turning white char
300	0-250	Material has fallen off specimen
308-318	250-350	Material is raised off specimen backing but still attached, curling back toward 750mm end of specimen
325		No smoke, no more flames
330		Pyrometer 3.92mv, test secured

IMO FLAME SPREAD TEST



B-2.107

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TEST: M3MDS4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	0-25	Spontaneous charring at impinging pilot
18	150-250	Spontaneous explosions, 150, 200,
20	350	Bubbles across surface 250mm
26	250	Complete charring and heavy black smoke
38	300	Progression of char and bubbles, heavy smoke
45		Pyrometer 3.77mv
50	0-150	Intermittent flames above and below center line about 1/2" off surface
63	0-100	Flames across specimen surface
70	0-100	Laminate is separating from specimen backing
75	0-150	Intermittent and steady flames about 4" height into stack
85		Laminate has separated and raised off specimen backing about 2"
94	0-100	Intermittent flames have ceased
98	100-150	Steady flame, decreasing
115	200	Intermittent flames
120-130	0-200	Laminate has separated and raised off specimen backing, leaning toward radiant panel still attached to specimen
135	450	Bubbles across specimen, light smoke
140	400	Light brown char line
160	200	Still have intermittent flames below the center line, burning separated material
194	225	Intermittent flames have ceased
200		Pyrometer 3.92mv, very light smoke
280		Pyrometer 3.93mv, smoke has ceased
295-310	0-250	No material left on center line, laminate has raised off specimen backing and leaning toward radiant panel about 2"

TEST: M3MDS4SP2 Specimen Number 4 (cont'd)

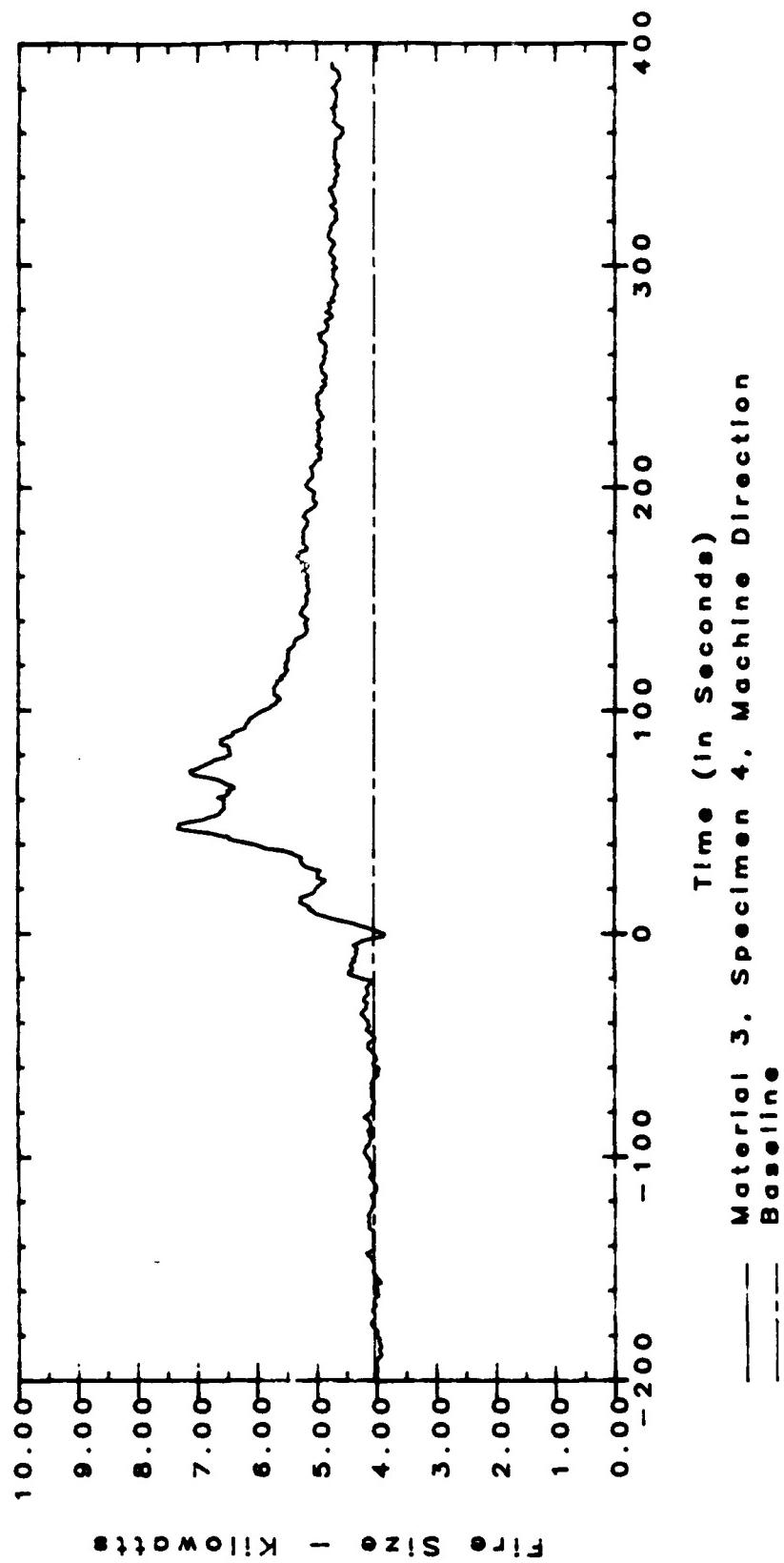
DATE: 29 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
320	250-400	Laminate split along center line and leaning toward radiant panel
335	400	Dark brown char line across specimen
342	450-475	Light brown char line
350	400-500	Bubbles across specimen above and below center line
365	0-200	Laminate has fallen off specimen, very little left around specimen holder
375		Pyrometer 3.93mv, test complete

IMO FLAME SPREAD TEST



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TEST: M3MDS5SP2 Specimen Number 5  
DATE: 30 July 1987  
MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
17-25	150-200	Spontaneous explosions
28		Horizontal pilot flame went out, secured fuel gas
32	up to 250	Heavy black smoke and char
45		Pyrometer 3.73mv
52	300	Black char, bubbles and heavy black smoke
85	0-100	Material is raised off backing about 1"
95	0-200	Alligated material across specimen
100	200-300	Heavy smoke
105	400	Bubbles and char line across specimen
150-160	0-150	Material is raised off backing about 2", still attached
165	0-150	Intermittent flames, red char on separated material
180	400	Dark brown char line
188	400-450	Light brown char line and bubbles
195	0-150	No material left on specimen except around the edges of holder
205	150-250	Intermittent flames, light smoke, material is raised off backing about 1"
245		Intermittent flames have ceased
250		Pyrometer 3.88mv
260	0-200	No material left on specimen
265-280	200-300	Material is split along center line and leaning toward radiant panel, about ready to fall, turning to white char, light smoke
285	400	Complete black char line
290	400-475	Light brown char line
295	500	Bubbles above and below center line
427		Pyrometer 3.85mv, all activities have ceased
445	0-250	Material has fallen off specimen except for around edges

TEST: M3MDS5SP2 Specimen Number 5 (cont'd)

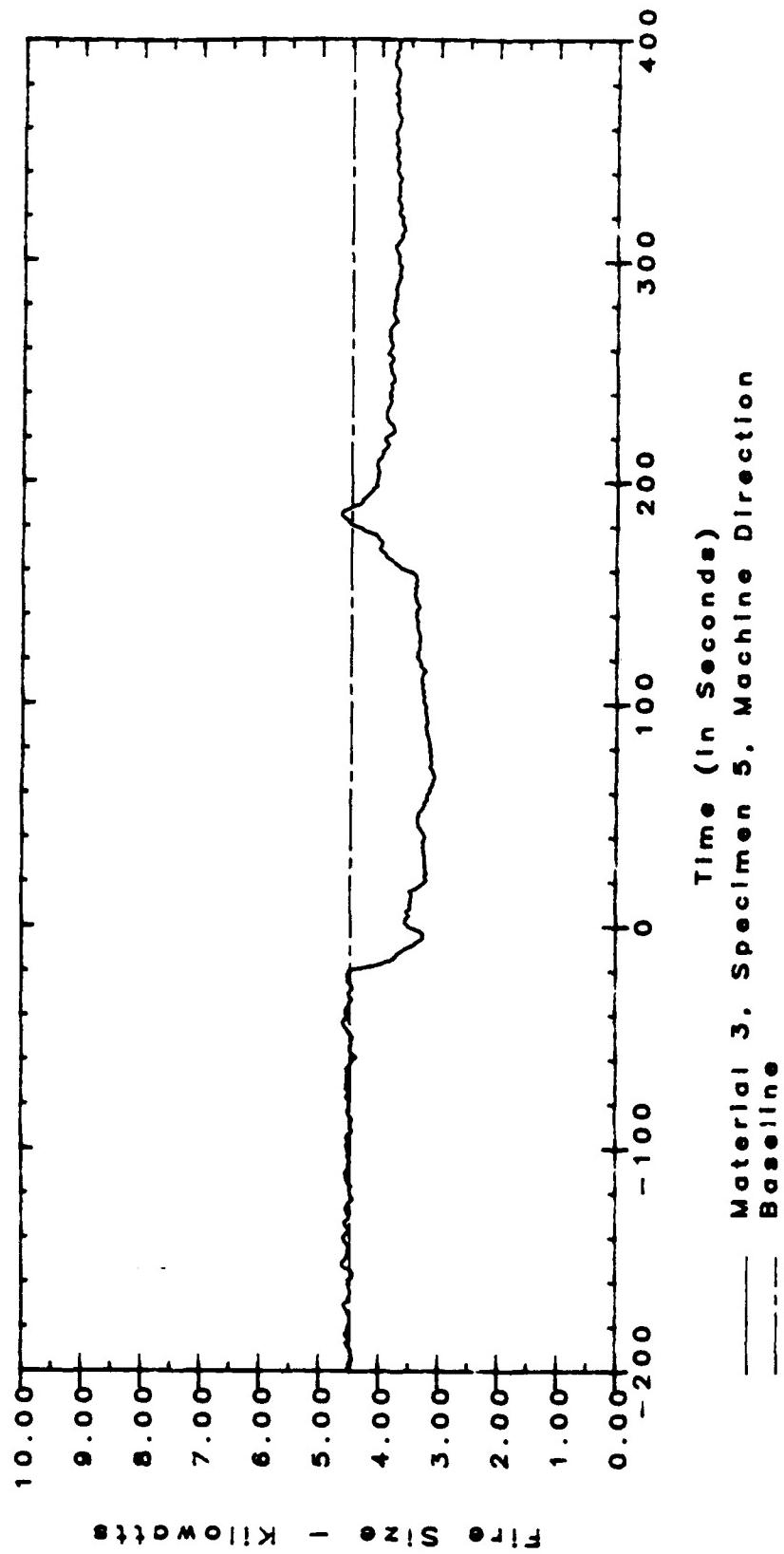
DATE: 30 July 1987

MATERIAL: High Pressure Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
465	250-400	Material is split along center line and raised off backing about 3" leaning toward panel
485	400-450	Complete black char line
490	450-525	Light brown char and bubbles above and below center line
500		Pyrometer 3.83mv, test complete

IMO FLAME SPREAD TEST



B-2.115

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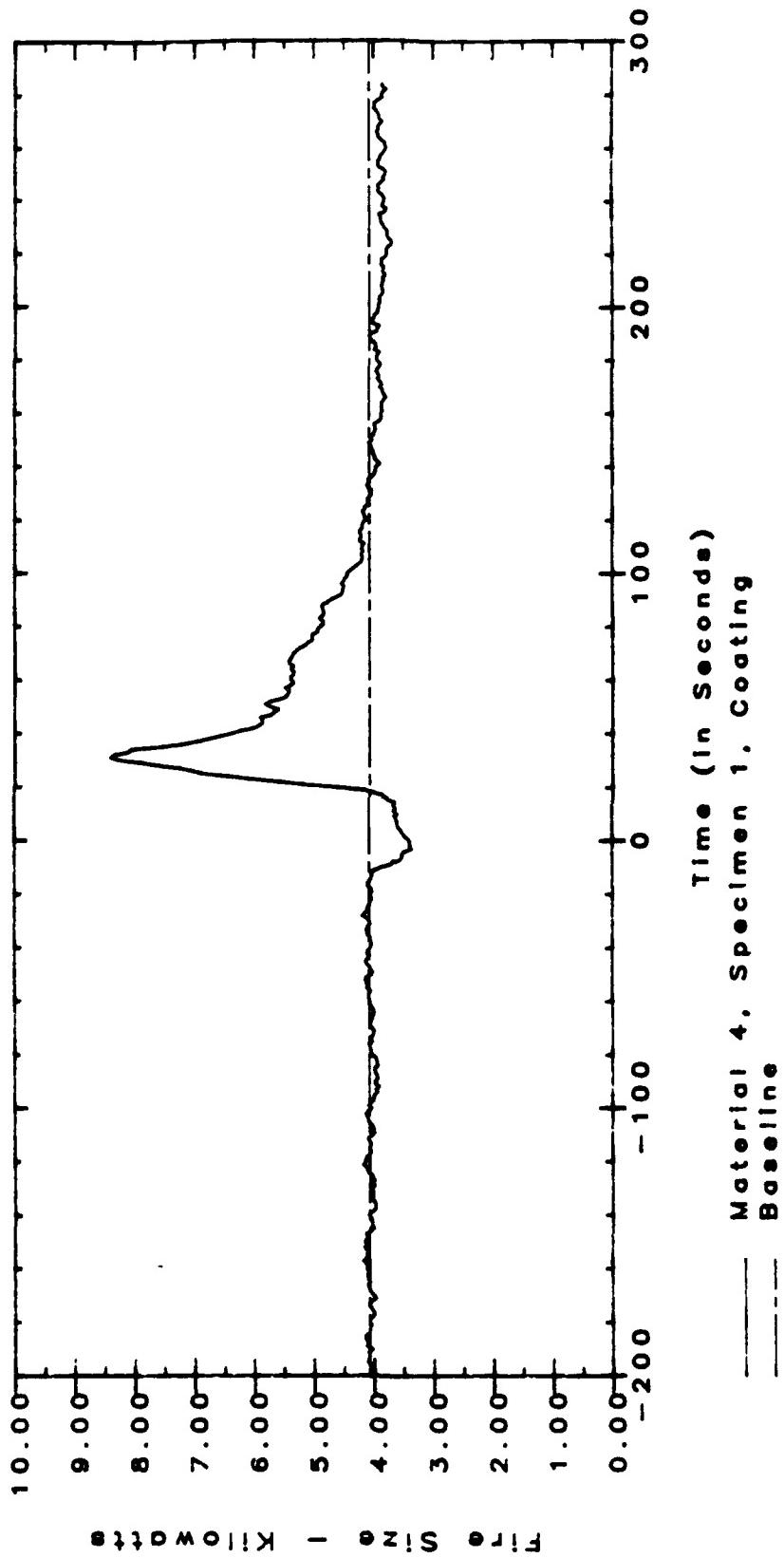
B-2.116

TEST: M4S1SP2 Specimen Number 1  
DATE: 20 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7-10	250	Light smoke, spontaneous bubbles across surface
12	150	Black char
15	300	Bubbles up to 300mm
18	0-200	Intermittent flames
25	300-400	Bubbles up to 400mm, complete black char up to 300mm
33	300	Flames, steady across surface
35		Material falling off after flames pass over it
37		Pyrometer 3.85mv
45	200	Material has fallen off specimen
50	300-350	Flames up to 300-350mm
55-65	450	Bubbles up to 450mm, flames decreasing about 4" in stack
70-78	300-350	Flame width 300-350mm
80	450	Bubbles
85	350	Flames have crossed center line
90-95	350	Flame spread at 350mm, crossing center line decreasing above centerline, flame out
100		Very light smoke
108	up to 350	Material raised from specimen
115	350-400	Light brown char line
120	400-525	Bubbles on surface about 1" dia.
127		Very little smoke
135		No more progression
140		Pyrometer 3.86mv
190		Pyrometer 3.87mv, very light smoke
205-215	0-350	Material has fallen off specimen, flame spread was 350mm, but fell off
235	400	Light brown char line
240-250	400-550	Bubbles on surface with some light char on top of bubbles, above center line
260		Pyrometer 3.89mv, test secured

IMO FLAME SPREAD TEST



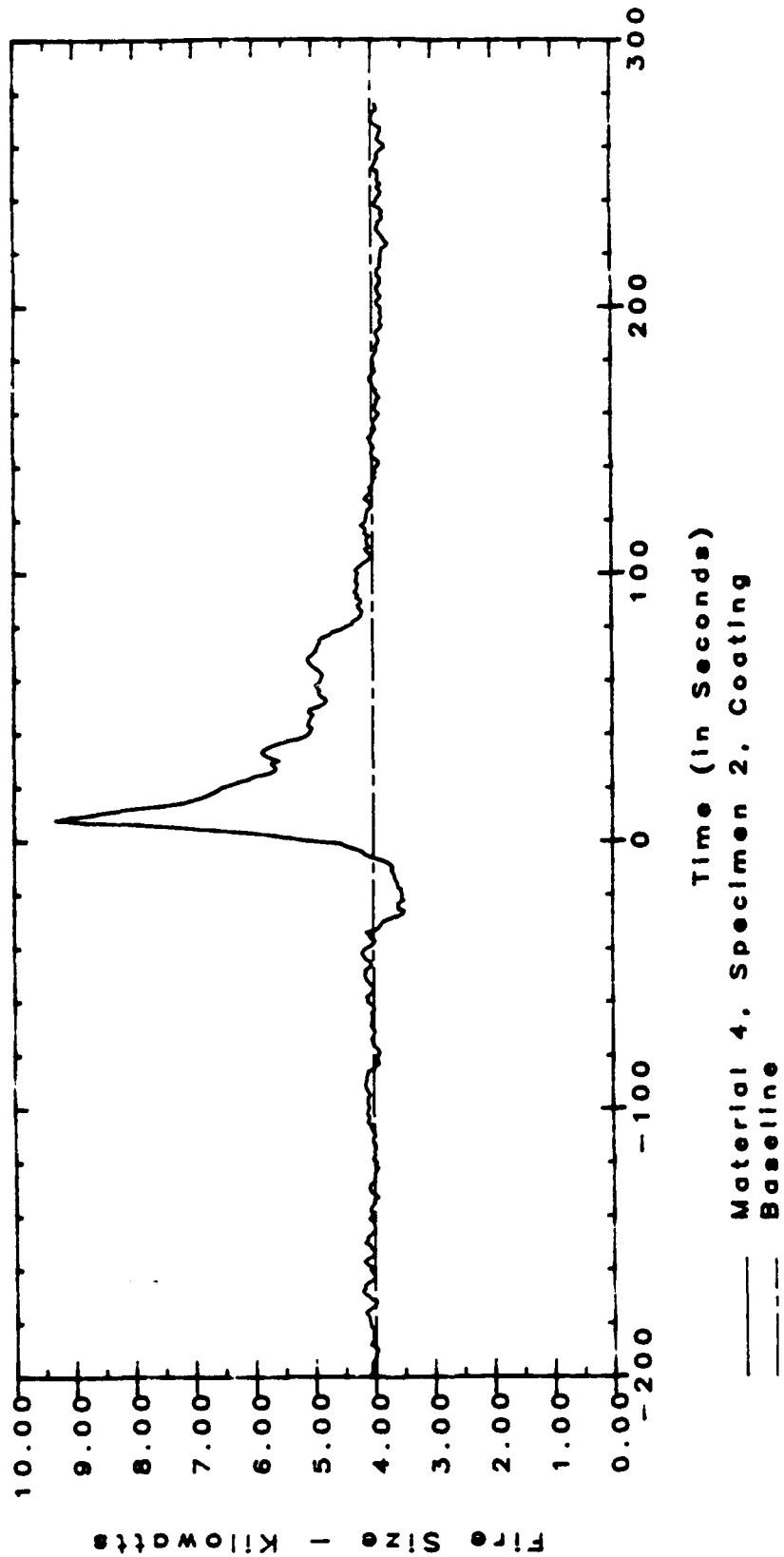
B2-118

TEST: M4S2SP2 Specimen Number 2  
DATE: 21 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5-13	200-250	Spontaneous bubbles up to 200, 250mm, moderate smoke, heavy smoke, bubbles are charred
15-20	0-250	Intermittent flames
25		Pyrometer 3.78mv
30-43	up to 300	Complete flaming up to 300mm across specimen surface, subject material is falling off specimen as flames progress
45-75	up to 300	All material has fallen off specimen and no flames
90	350	Intermittent flames about 4" into stack
100		Intermittent flame is out
107		Pyrometer 3.85mv
115		Very little smoke
128	up to 475	Surface bubbles across surface
160		Pyrometer 3.85mv
183		Very light smoke
248-260	0-350	Final appearance, pyrometer 3.87mv, no material on specimen
265	350-450	Light brown char
275	450-525	Bubbles across surface above and below center line
285		Pyrometer 3.88mv

IMO FLAME SPREAD TEST



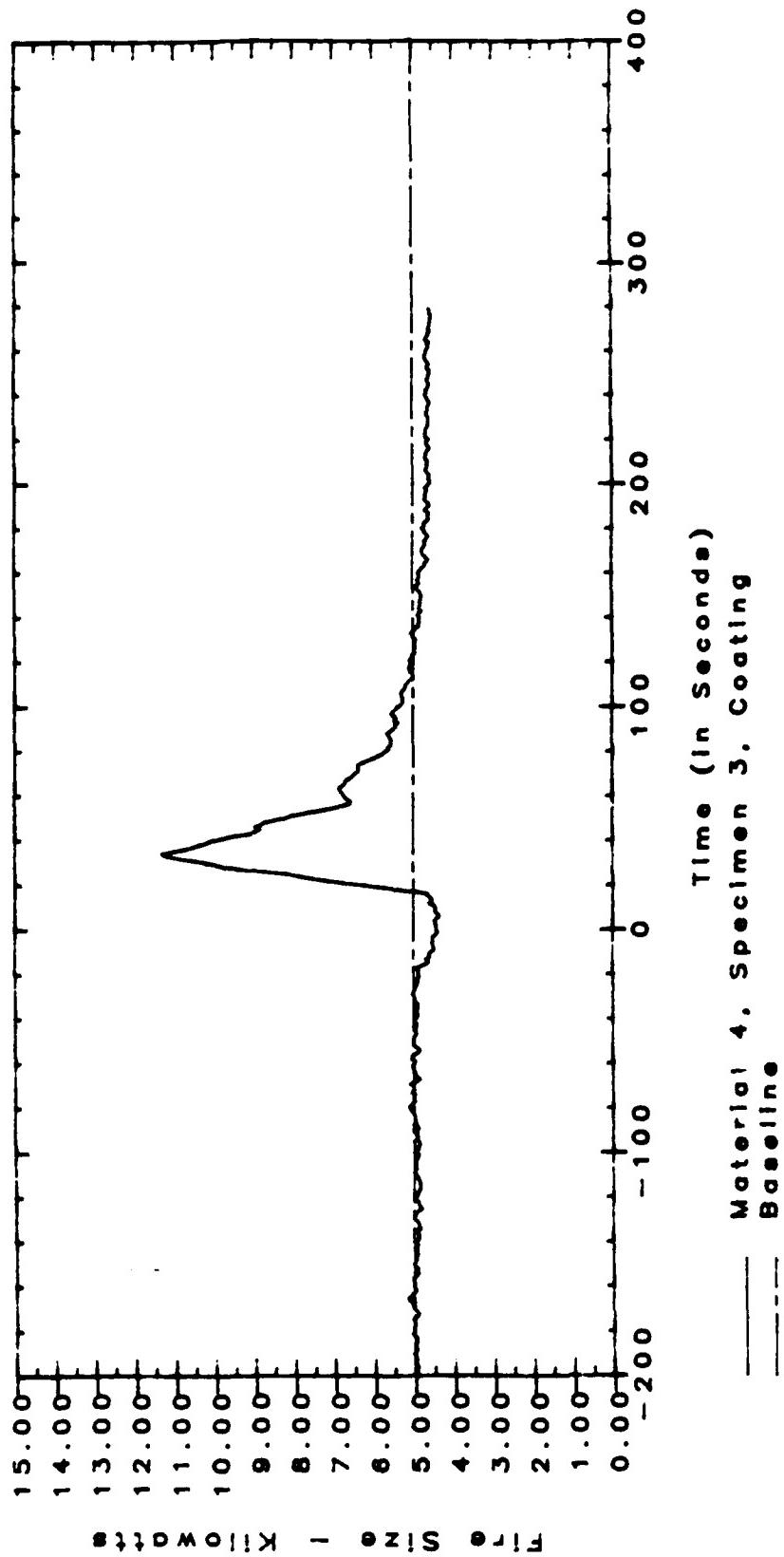
B-2.120

TEST: M4S;SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10	250-300	Spontaneous bubbles
14		Surface charring, heavy smoke
20	0-200	Intermittent flames across surface, going out
30	400	Bubbles across surface above and be- low center line
35-45	0-300	Flames are steady now, 6" height in- to stack, material is flaking off specimen backing as the flame progresses
50	0-200	No material on specimen
55	300-350	Flames about 6" height into stack
60		Pyrometer 3.88mv
70	300-350	Flames about 4" height into stack
80		Flame has ceased
90-100	0-300	No material left on specimen, coating has fallen off specimen as flame progressed
105	300-350	Complete black char
110-115	350-450	Bubbles on surface above and below center line, with light char on top of bubbles
120	450-550	Bubbles above and below center line
125		Light smoke, pyrometer 3.88mv
210		Pyrometer 3.88mv, no more smoke
220-230	0-350	No material left on specimen, fell off as flame progressed
235	350	Dark brown char line
240	350-450	Bubbles on surface are light brown char
250	450-550	Bubbles across specimen above and below center line
265		No flame spread, pyrometer 3.90mv

IMO FLAME SPREAD TEST

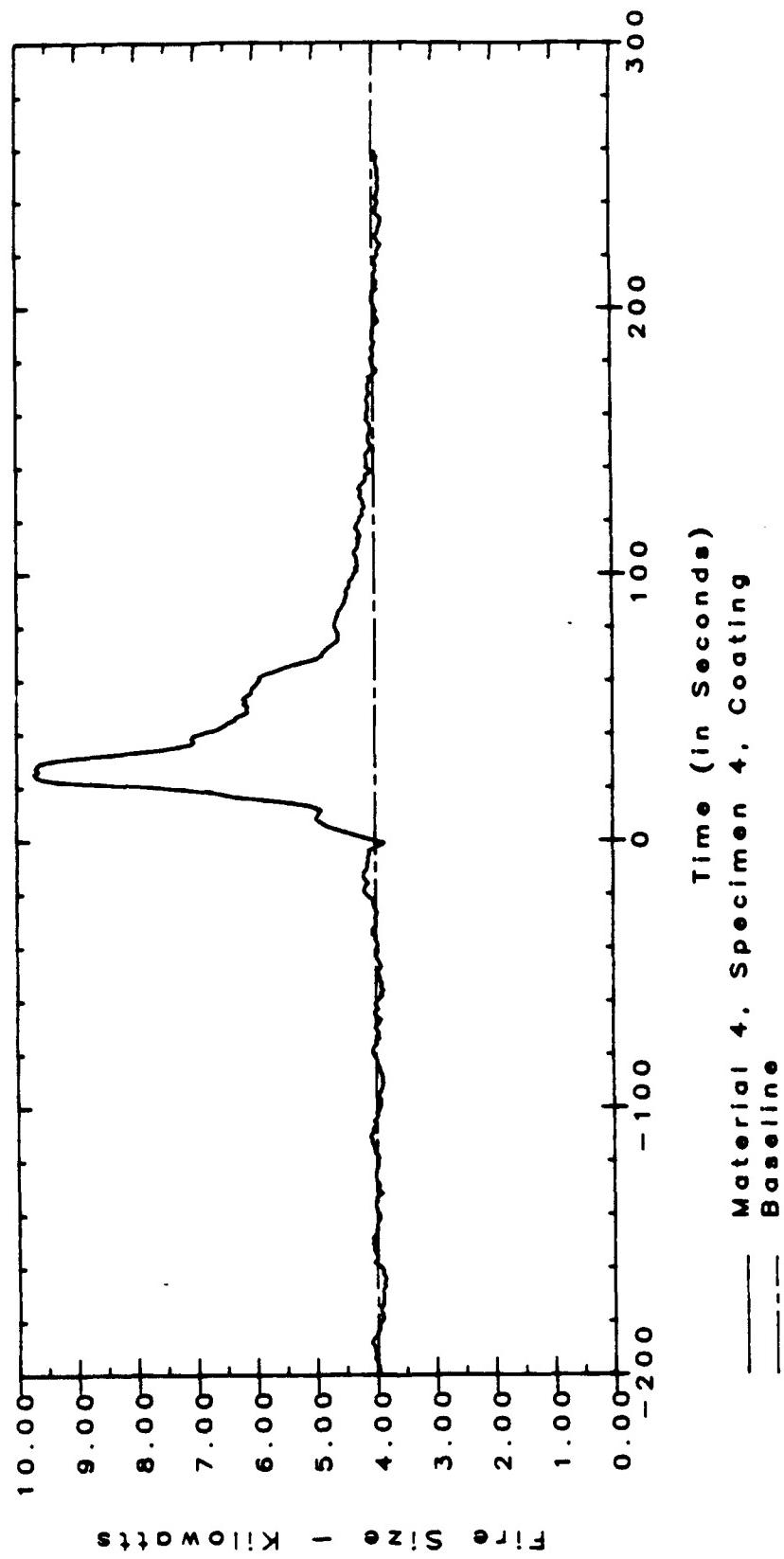


TEST: M4S4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	200-300	Spontaneous bubbles across specimen above and below center line
15	0-200	Intermittent flaming
20	0-250	Flames are steady now with material falling off specimen as flames progress
30	400	Progression of bubbles across specimen
35	300	Progression of dark char
45	0-200	No material left on specimen
52	200-300	Flames across specimen 4" height into stack
55	400	Progression of bubbles across specimen
60	350	Progression of char line across specimen
65		Pyrometer 3.86mv
75		All flaming has ceased, light smoke
80-95	0-300	No material left on specimen backing, material flaked off as flames progressed
100	300-350	Material is leaning away from specimen backing but is still attached to sample
115	500	Progression of bubbles above center line
120	450	Progression of bubbles below center line
125	450	Char on top of bubbles up to this position
133		Pyrometer 3.86mv, very light smoke, no more flaming
195		Pyrometer 3.88mv, no smoke, no further progression
200-215	0-300	Material has flaked off specimen as flames progressed across specimen during test
220	300-350	Material separated from specimen backing and starting to flake off
228	400-550	Bubbles across specimen above and below center line
234		Top of bubbles are charred
240	500	Pyrometer 3.88mv, test complete

IMO FLAME SPREAD TEST



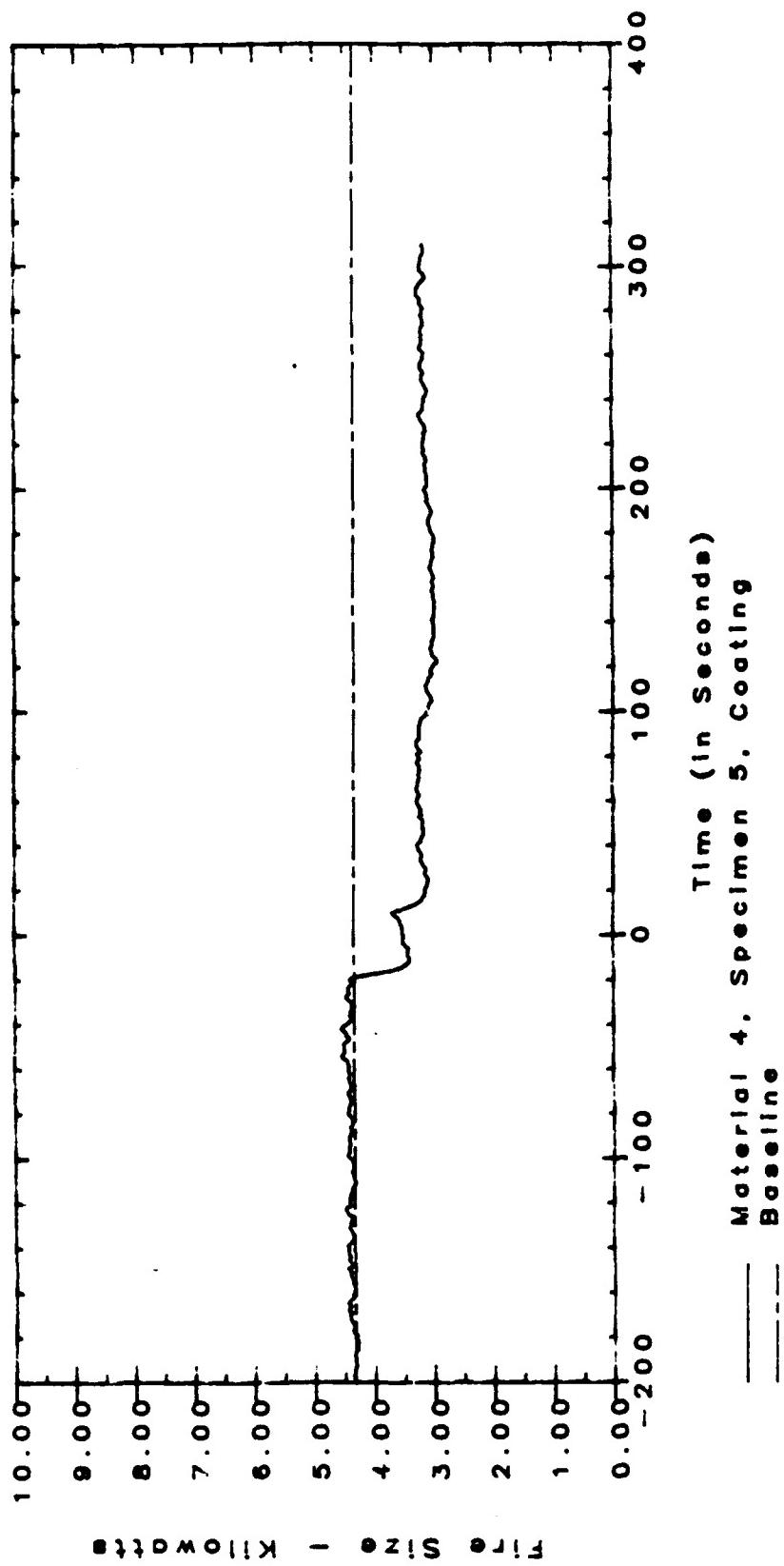
B-2.124

TEST: M4S5SP2 Specimen Number 5  
DATE: 30 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10	300	Spontaneous surface bubbles
15		Horizontal pilot flame went out, secured fuel gas
23		Heavy black smoke
30	200	Black char
35	300	Char on top of bubbles
40	400	Bubbles across specimen
50	200	Heavy black smoke, material is falling off specimen from 0-200mm
60		No flames
70		Moderate smoke
100-175	0-200	No material is left on specimen
105	400	Heavy black char
110	450	Bubbles above and below center line
120	0-300	No material is left on specimen
125	425	Char line across specimen
135		Pyrometer 3.78mv
265		Pyrometer 3.82mv, all activities have ceased
270	0-350	No material is left on specimen
275	350-450	Light brown char across specimen
280	450-525	Bubbles above and below center line
290		Material flaked off specimen as heat progressed
300		Pyrometer 3.84mv, test complete

IMO FLAME SPREAD TEST



B-2.126

TEST: M5S1SP2 Specimen Number 1  
DATE: 20 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
12	150-200	Spontaneous bubbling across the surface up 150-200mm above and below center line
18	150-200	Heavy smoke, flickering flames
22	200	Complete flames across the surface
25	250-400	250mm flames above the center line, complete bubbles up to 350-400mm
35	250	Flame up to 250mm across the surface
45	300	Constant flames up to 300mm, height of flame about 10" with 6" up into stack
50	350	Flames increased up to 350mm
57	350-450	Bubbles across the surface
65	100-350	Flames are from 100-350mm
67	0-100	No flame, turning white char, surface alligatoring
85	400	Flame spread 400mm at center line
95	300-400	Flames
105	0-300	No flames, surface alligatoring
110-120	400	Intermittent flames at 400mm, slowly progressing, flame width about 50mm above and below center line
130-150	425	Very light smoke, flame is still about 50mm in width, flame spread up to 425mm at center line
165-170	425	Flame at center line at 425mm, below center line, no flames
175-180	425	Flame has crossed center line, above center line flame has ceased
190	425-450	Complete black char above center line
195	450-550	Bubbles on surface
200	300-450	Complete black char
202	0-300	White char, alligated surface, material has separated from specimen backing, very little smoke

TEST: M5S1SP2 Specimen Number 1 (cont'd)

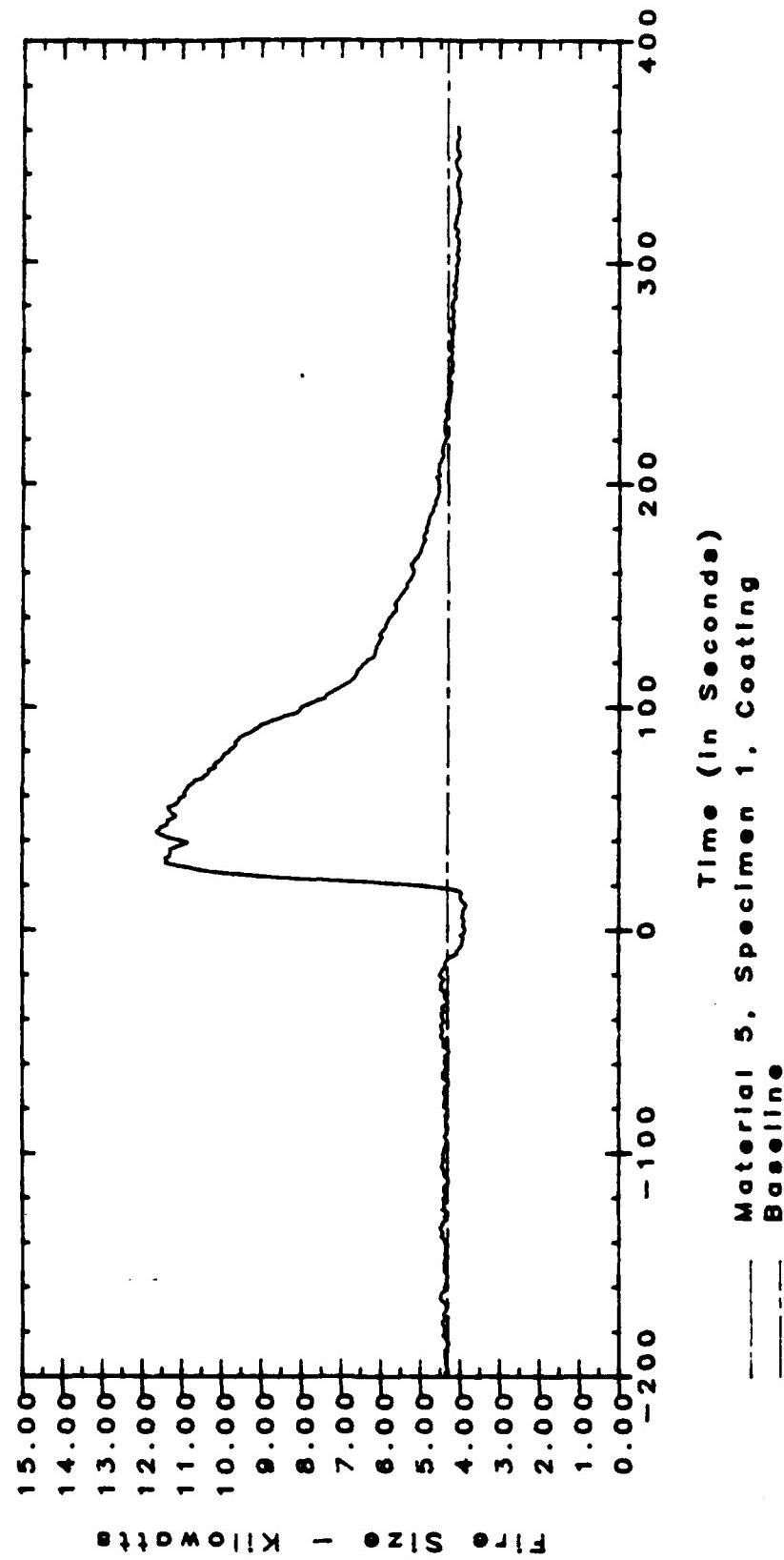
DATE: 20 July 1987

MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
210		No more flame
245		Pyrometer 3.90mv
250-275	0-350	No material on surface of original backing
260-285	350-450	Black char, starting to turn to white char, 425mm flame spread char line
295	450-600	Bubbles on surface, very light smoke
310		Pyrometer 3.89mv
355		No change since last description, test secured at 600 sec. with 200 sec. background

IMO FLAME SPREAD TEST



B-2.129

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B-2.130

TEST: M5S2SP2 Specimen Number 2  
 DATE: 21 July 1987  
 MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

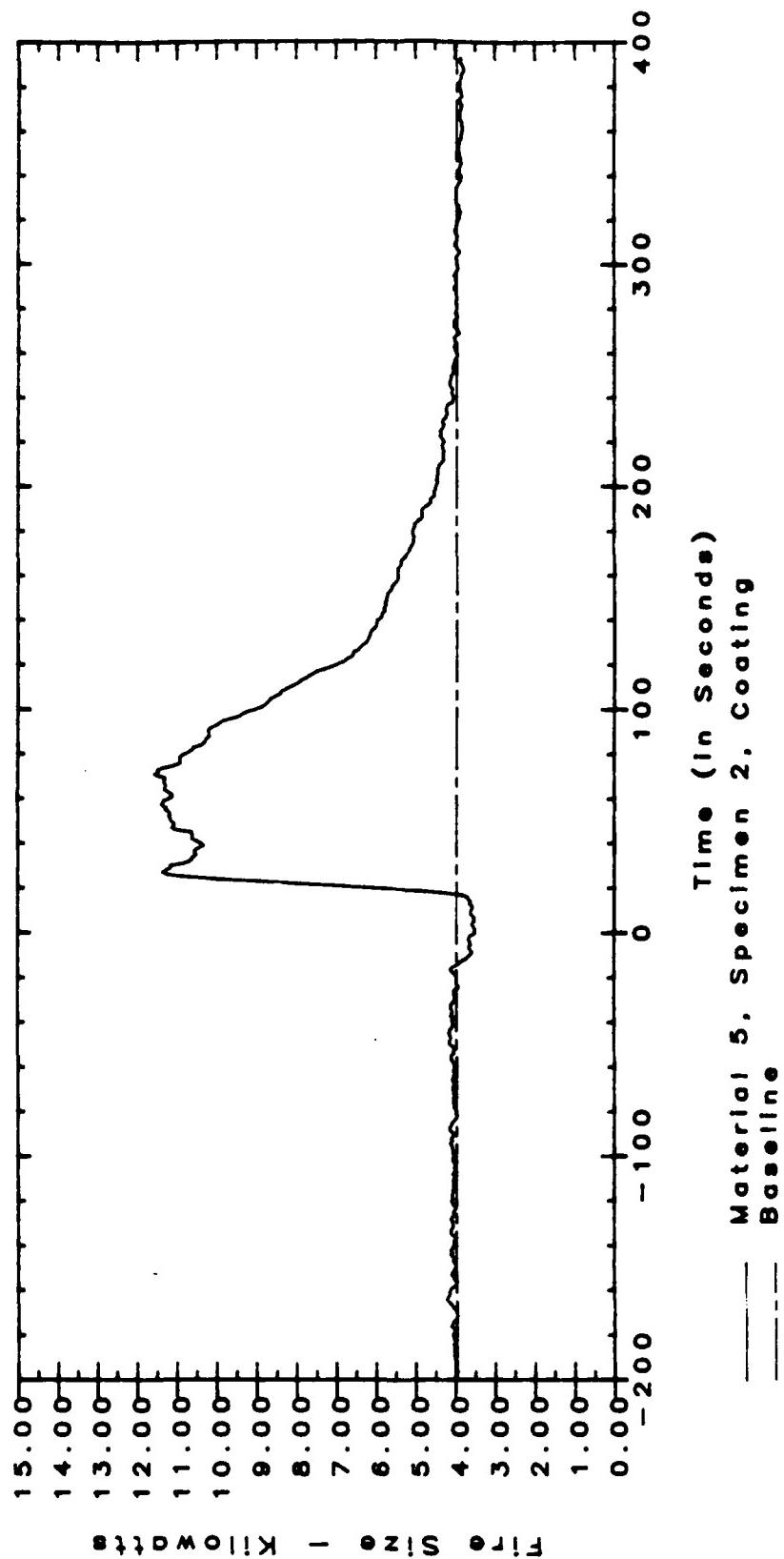
Time (sec)	Distance (mm)	Remarks
11-17	250-350	Spontaneous bubbles at 250,300,350mm
20-27	up to 250	Flaming up to 250mm, across the specimen, flames about 6-8" into stack
30-35	300-400	Flames up to 300mm, bubbles up to 400mm, flames orange colored
40		Pyrometer 3.82mv
50-60	350-500	Bubbles progressed up to 500mm, flames progress 350mm at center line, still about 8" into stack
75	0-200	Intermittent flames on top of specimen
80-90	200-400	Flames across specimen, 6" into stack
95		Material is alligated across specimen and flaking off
100-115	300-425	Flames have decreased, 4" into stack
120	350-400	Flames decreasing rapidly, between 350-400mm, only flames on specimen now
130		Intermittent flames have ceased, light smoke
135	0-250	Material is white char, light smoke
145	400	Still have flaming at 400mm above and below center line
153		Light smoke, pyrometer 3.97mv
180	450	Flame has intersected center line, producing a flame spread
185		Pyrometer 3.96mv
193-205	450	Flame has decreased, flame is out, position 450mm above center line, light smoke
230	0-100	Specimen white char, some fell off
238	100-300	White char, material flaking
253-260	300-450	Dark black char, with flame spread at 440mm
265	up to 600	Light smoke, surface bubbles 1-2" in dia.

TEST: M5S2SP2 Specimen Number 2 (cont'd)  
DATE: 21 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
273		Pyrometer 3.94mv
325		Final appearance, pyrometer 3.93mv
340	0-200	Material has fallen off specimen
345	200-350	White char, alligated, could fall off anytime
355	350-450	Black char above and below center line
365	450-625	Surface bubbles 1-2" in dia. with light brown char on top of bubbles up to 500mm
380		No more flaming, test complete

IMO FLAME SPREAD TEST



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B-2.134

TEST: M5S3SP2 Specimen Number 3

DATE: 27 July 1987

MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

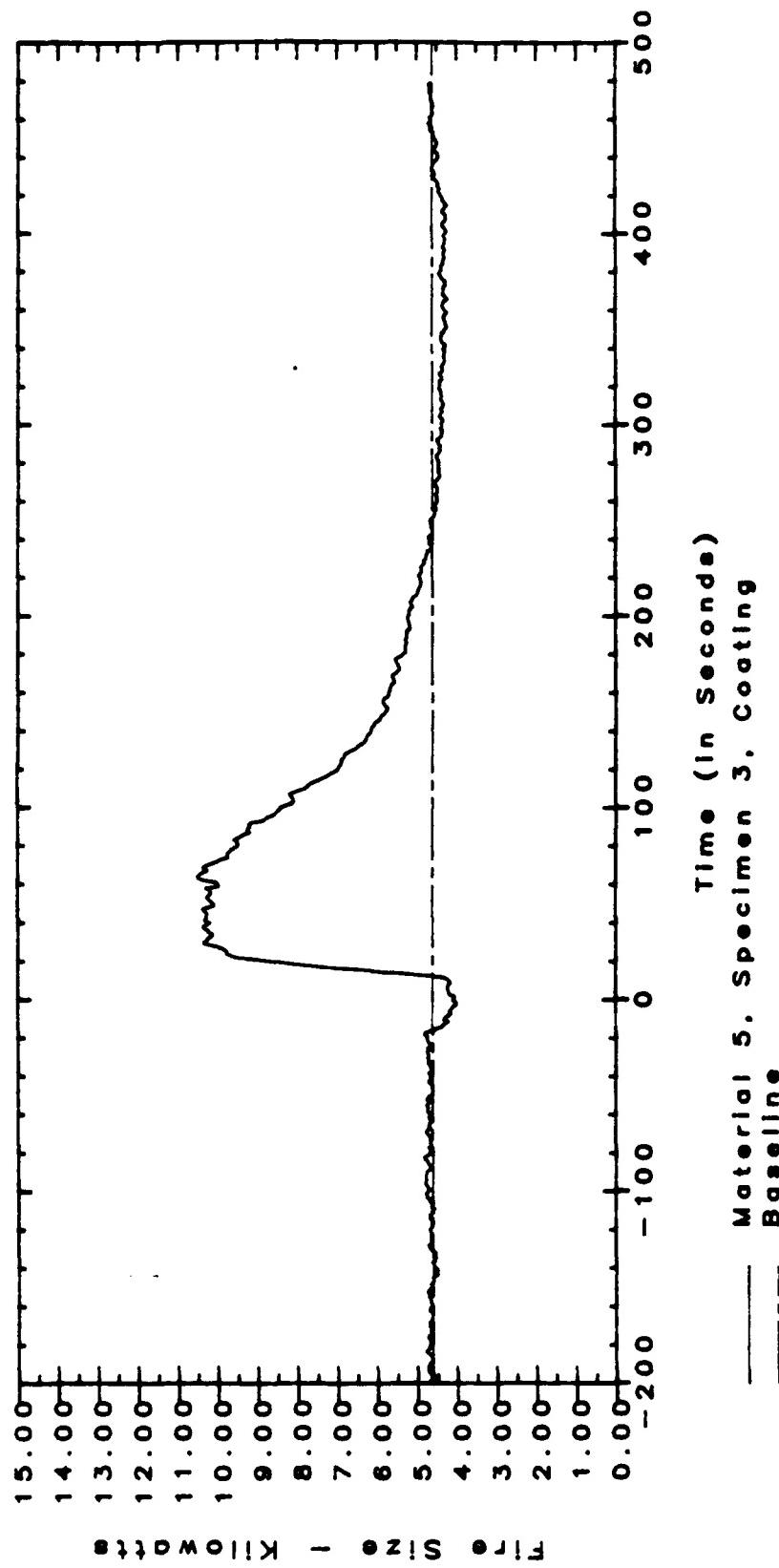
Time (sec)	Distance (mm)	Remarks
10	100-250	Spontaneous bubbles
14	100-200	Intermittent flames
20	350	Bubbles across surface
25-30	0-300	Steady flames now, across specimen 8" (height) into stack, orange color, above center line
38	0-300	Black char below center line, flames above
40	450	Bubbles across specimen above and below center line
45		Flames 6" (height) into stack
50	0-50	All flames have ceased
52-58	50-350	Flames across specimen above and below center line, 6" (height) into stack
60		Pyrometer 3.98mv
70-80	0-100	Flames have ceased, material turning and separating from back of specimen
90	100-300	Intermittent flames
95	300	Flames are steady
100		All intermittent flames have ceased
102-115	300-400	Steady flame across specimen, progressing slowly, looks like we got a flame spread on this one!
125		Flames are about 3" into stack, de- creasing
130-135	400	Flame is at the 400mm mark about 1/2" wide above and below center line
145	0-400	All flames have ceased
148-153	400-425	Flame across specimen above and below center line
155-165	0-400	Material is alligated and separ- ating from specimen backing, turning white char
170	450	Flame above and below center line, about 3" into stack
180		Pyrometer 3.97mv
192		Flames are decreasing

TEST: M5S3SP2 Specimen Number 3 (cont'd)  
DATE: 27 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
210-220	460	Small flame across specimen above and below center line
225-233	460	Flames have ceased below center line with intermittent flames above center line, flickering on and off, flames are out, no more flames on specimen
235		Pyrometer 3.98mv, very light smoke
240-250	460	Flame spread of 460mm at intersection of center line
275-295	440	440mm at bottom of specimen is the beginning of flame spread mark
300-308	475	475mm at top of specimen is end of flame spread mark, with intersection at 460mm
325		Pyrometer 3.95mv, no more smoke, no flames
340-345	0-100	Material has fallen off below center line, above center line turning to white char and separating
350-360	100-350	Material is white char, alligated and separated from specimen backing
370	350-400	Complete black char, final flame spread position
380	460-500	Light brown char with surface bubbles
390	500-650	Bubbles on specimen above center line
405	550	Bubbles above and below center line
410	0-250	No material on specimen, just fell off
430	250-350	Black with char, no other changes in specimen
445		Pyrometer 3.96mv, test secured

IMO FLAME SPREAD TEST



B-2.137

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B-2.138

TEST: M5S4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

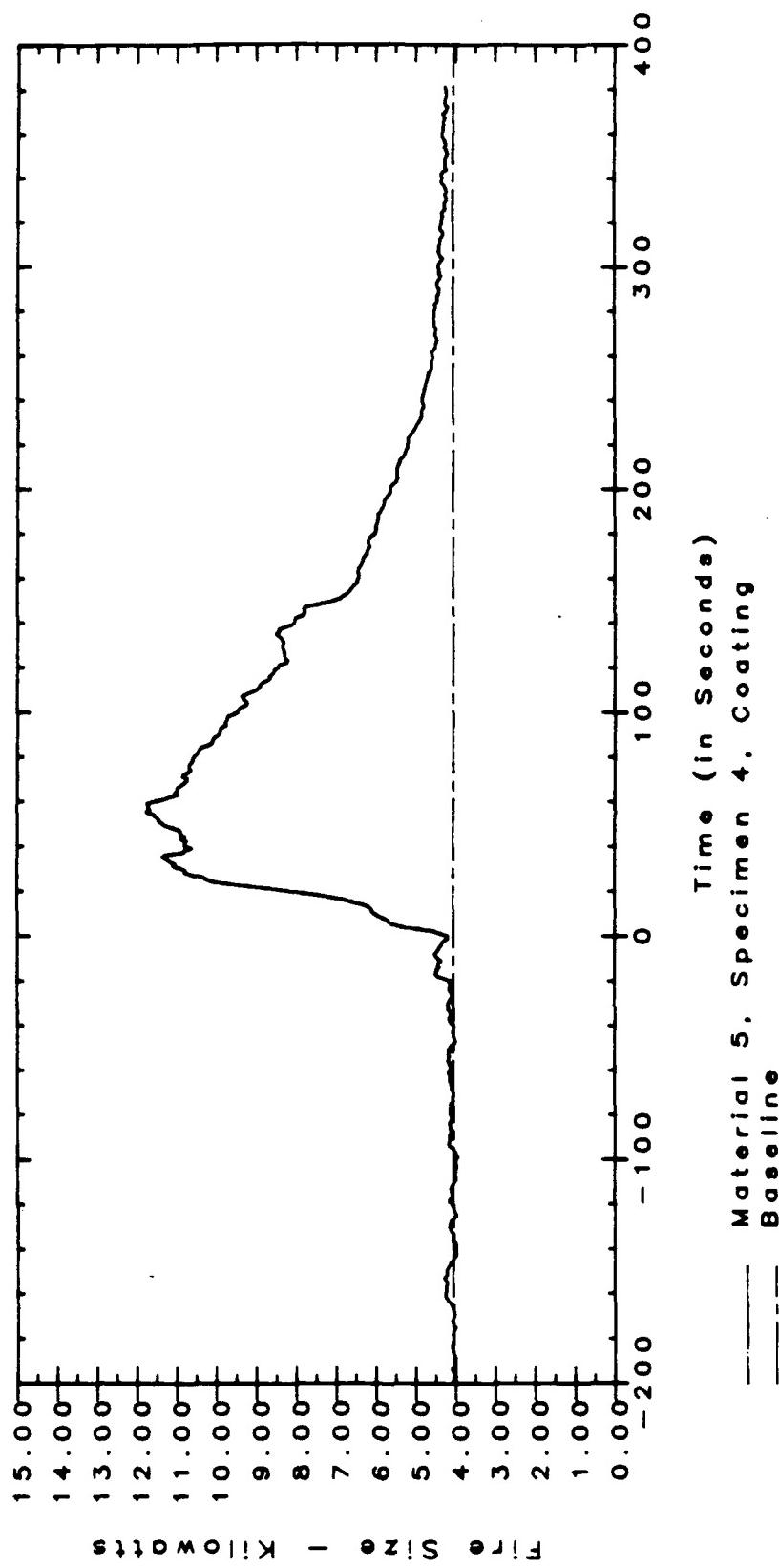
Time (sec)	Distance (mm)	Remarks
9	up to 200	Spontaneous bubbles
12	0-50	Spontaneous flaming
15	300	Progression of bubbles
20	200	Progression of flames, intermittent
25-35	0-250	Intermittent flames are steady now across specimen, above and below center line about 8" in height
38	400	Bubbles across specimen above and below center line
42	0-300	Flames across specimen
46		Pyrometer 3.92mv
65	0-50	All flames have ceased
70-78	50-350	Steady flames about 6" (height) into stack, orange in color
85	500	Bubbles across specimen above and below center line, no char line on specimen
97	0-200	All flames have ceased
102	200-400	Steady flame across specimen about 5" into stack, orange in color
125	0-200	Material has fallen off specimen in one large section
132	0-300	All flames have ceased
135-145	300-425	Flames across specimen above and below center line, orange in color, decreasing
155	200-400	Material has separated from specimen
175	0-400	Flames have ceased
180	400-450	Steady flame decreasing in size, 3" into stack
192	350	Light smoke, material turning white char starting to flake off specimen
200	0-200	No material on specimen except for the bottom of specimen holder
207	450	Intermittent flames above center line flickering on and off, there is a flame spread
225		Flames are above center line, decreasing 2" height into stack, width of flame about 25mm
230		Flames are out at this time, ceased
235		Pyrometer 3.96mv

TEST: M5S4SP2 Specimen Number 4 (cont'd)  
DATE: 29 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
245-275	425-475	425mm at bottom is the start of char line, 460mm char line intersects center line forming flame spread distance, 475mm at top of holder char line ends
315	0-150	Material has fallen off specimen
335	150-400	Material has separated from backing with alligated surface and white char
345-355	400-475	Black char line ranging from 425mm at bottom and 475 at top of specimen intersecting the center line
360	550	Bubbles across specimen above and below center line
372		Pyrometer 3.92mv, test complete at 460 mm creating a flame spread distance

IMO FLAME SPREAD TEST



B-2.141

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TEST: M555SP2 Specimen Number 5  
 DATE: 30 July 1987  
 MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

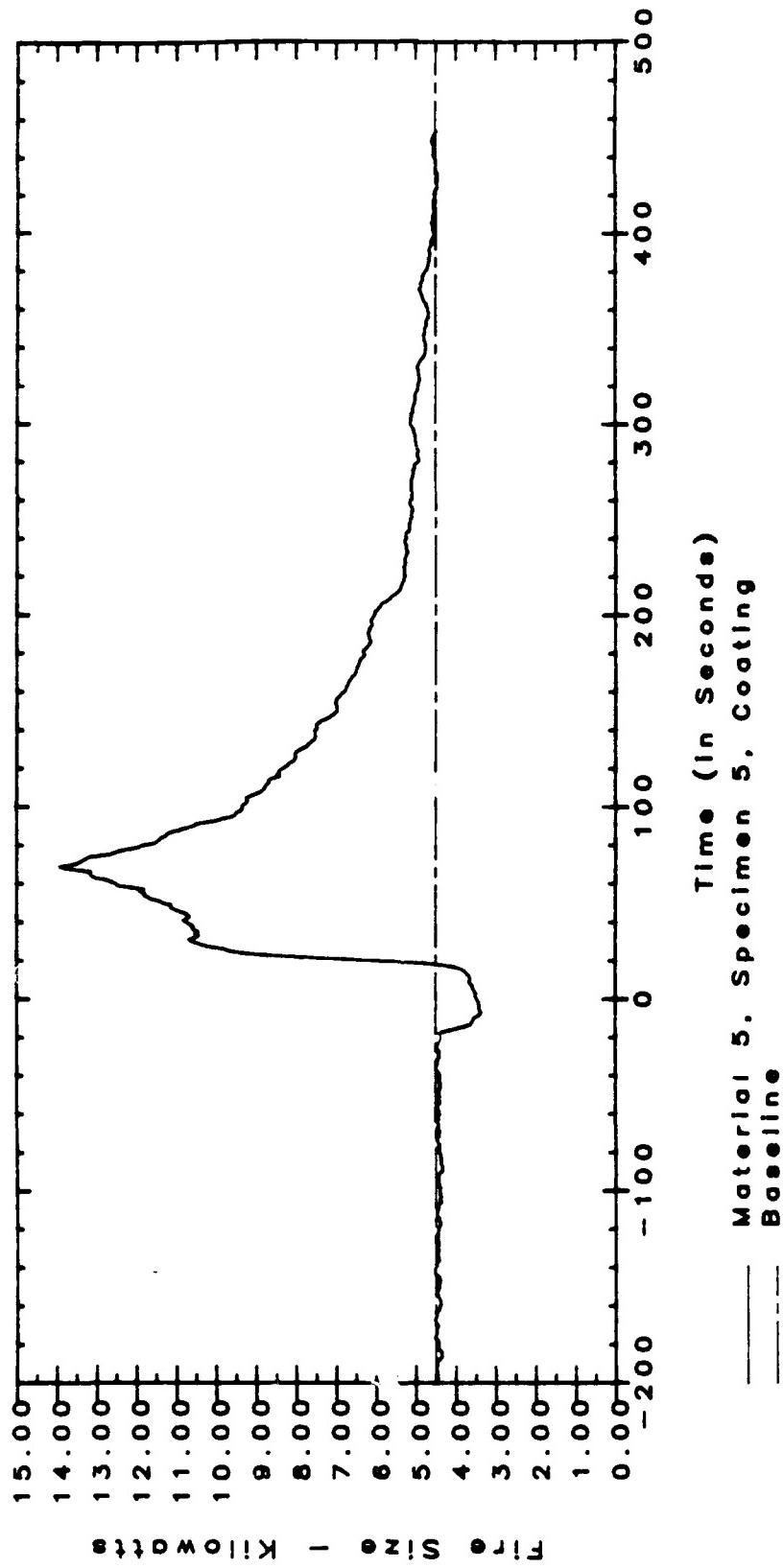
Time (sec)	Distance (mm)	Remarks
16	250	Bubbles across surface
20	250	Intermittent flames turning steady now about 6" into stack, across specimen
32	400	Bubbles across surface
35-50	300	Flames across specimen 8" into stack
55	350	Flame spread distance
65-80	0-200	Material has separated and fallen off specimen, remaining adhesive still burning
85	400	Flame spread distance
105	0-300	Intermittent flames have ceased
110	300-400	Flames across specimen about 5" into stack, orange in color
140	0-350	All flames have ceased
145-155	350-450	Flames forming a curve on face of specimen with 350mm at bottom, flames decreasing about 2" (height), light smoke
160	550	Bubbles above and below center line
175	0-350	No material is left on specimen
185	400-450	Flames about 2" into stack
190-205	450	On a curve, flames have intersected 450mm center line, to 460mm above center line
212	550	Bubbles above and below center line
215		Pyrometer 3.91mv
235		Flames are decreasing leaving black soot line on specimen
257	450	Intermittent flames have ceased below center line
270	475-500	Flame above center line
300	0-450	No material left on specimen
320-330	450-500	Flames across specimen with intersection of center line at 500mm
345	575-600	Large bubble about 2" in dia.
354	500-600	Bubbles above and below center line
360		Pyrometer 3.89mv, still have steady light flames
390		All flames have ceased
405	500	Flame distance is black soot line ranging from 425mm bottom, to 525mm on top

TEST: M5S5SP2 Specimen Number 5 (cont'd)  
DATE: 30 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
430	0-450	No more material is left on specimen
440		All other positions are still the same
455		Pyrometer 3.90mv

IMO FLAME SPREAD TEST



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TEST: M6S1SP2 Specimen Number 1  
DATE: 20 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

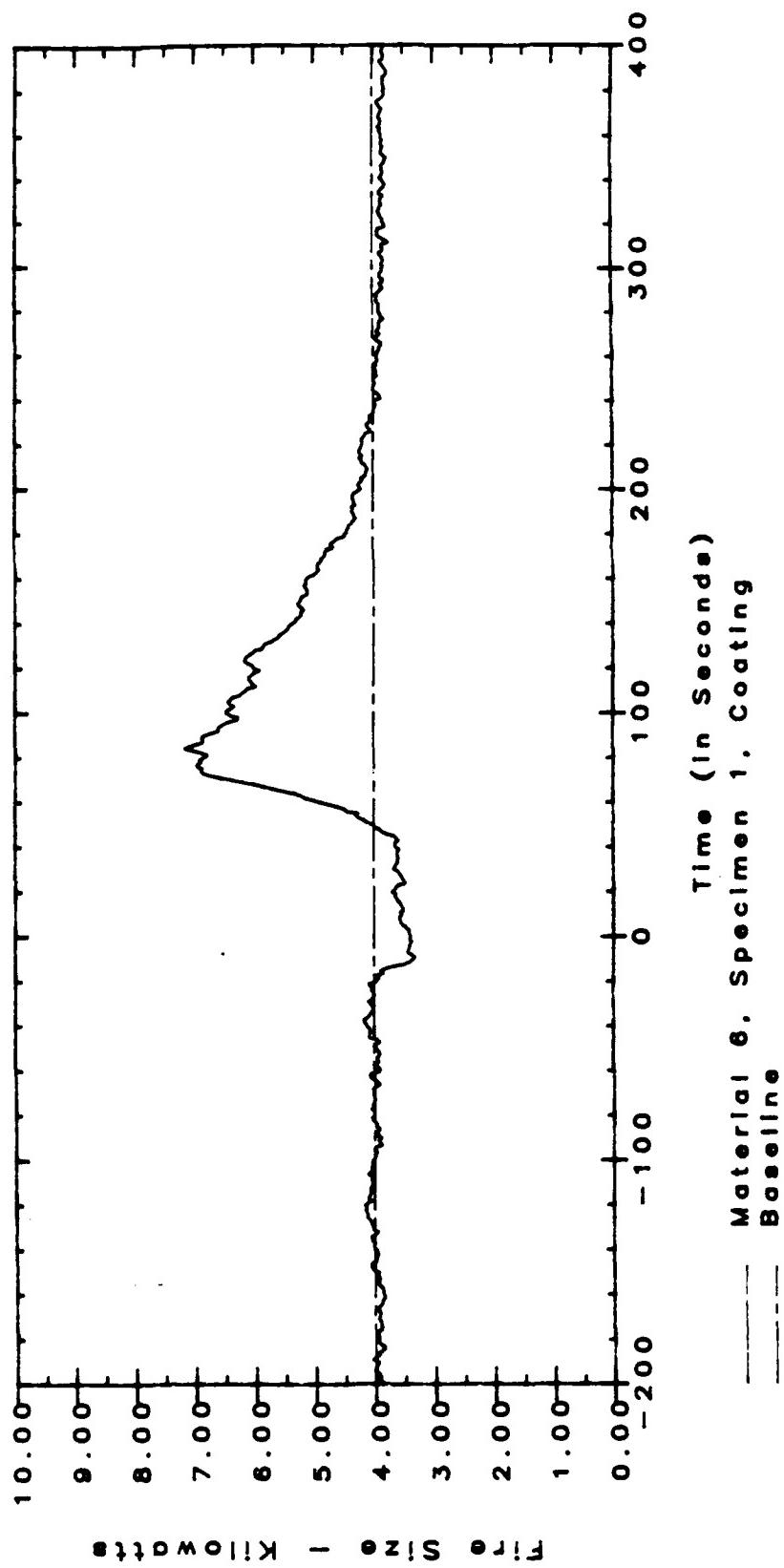
Time (sec)	Distance (mm)	Remarks
12		Pyrometer 3.78mv
15-25	200-250	Spontaneous bubbles up to 250mm, charring up to 200, heavy black smoke across face of surface
30-40	250	Heavy smoke up to 250mm with large bubbles on surface
45	400	Bubbles up to 400mm across surface
47-60	0-50	Intermittent flames, air coming from bubbles are increasing flame
65	150	Flames progress up to 150mm across surface
70		Heavy black smoke
80	200	Flames up to 200mm, 8" into stack heavy smoke
85	350	Black char
95	350-500	Bubbles across surface
100-110	50-300	Intermittent flames, smoke and char
120		Slight alligatoring, flames across holder and not specimen
132	200-250	Flaming across specimen above and below center line
142	400	Heavy black char
145	550	Bubbles up to 550mm across surface
150		Pyrometer 3.93mv
160		Intermittent flames above center line
165		No flame spread
175	200-250	Flaming out
180		Very light smoke
190		Material has separated along center line only, 1/2" crack, still attached
195	400	Black char line
200	450	Large bubbles
205	550	Small bubbles
210		Pyrometer 3.93mv
217		Very light smoke
225	0-100	White char across surface
230	100-200	White char below center line, black above
240	200-400	Complete black char
246	400-450	Light char
252	450-550	Bubbles across surface

TEST: M6S1SP2 Specimen Number 1 (cont'd)  
DATE: 20 July 1987  
MATERIAL: Coatin~

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
255		Very light smoke
260		Pyrometer 3.93mv
325		Pyrometer 3.93mv
340	400	Material is cracked down center line 400mm, is raised from backing about 1/2"
355	0-200	Complete white char
360	200-250	Light brown char, charcoal
368	250-450	Black char across surface
375	450-550	Bubbles on surface
380		Pyrometer 3.92mv

IMO FLAME SPREAD TEST



B-2.149

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B-2.150

TEST: M6S2SP2 Specimen Number 2  
DATE: 21 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

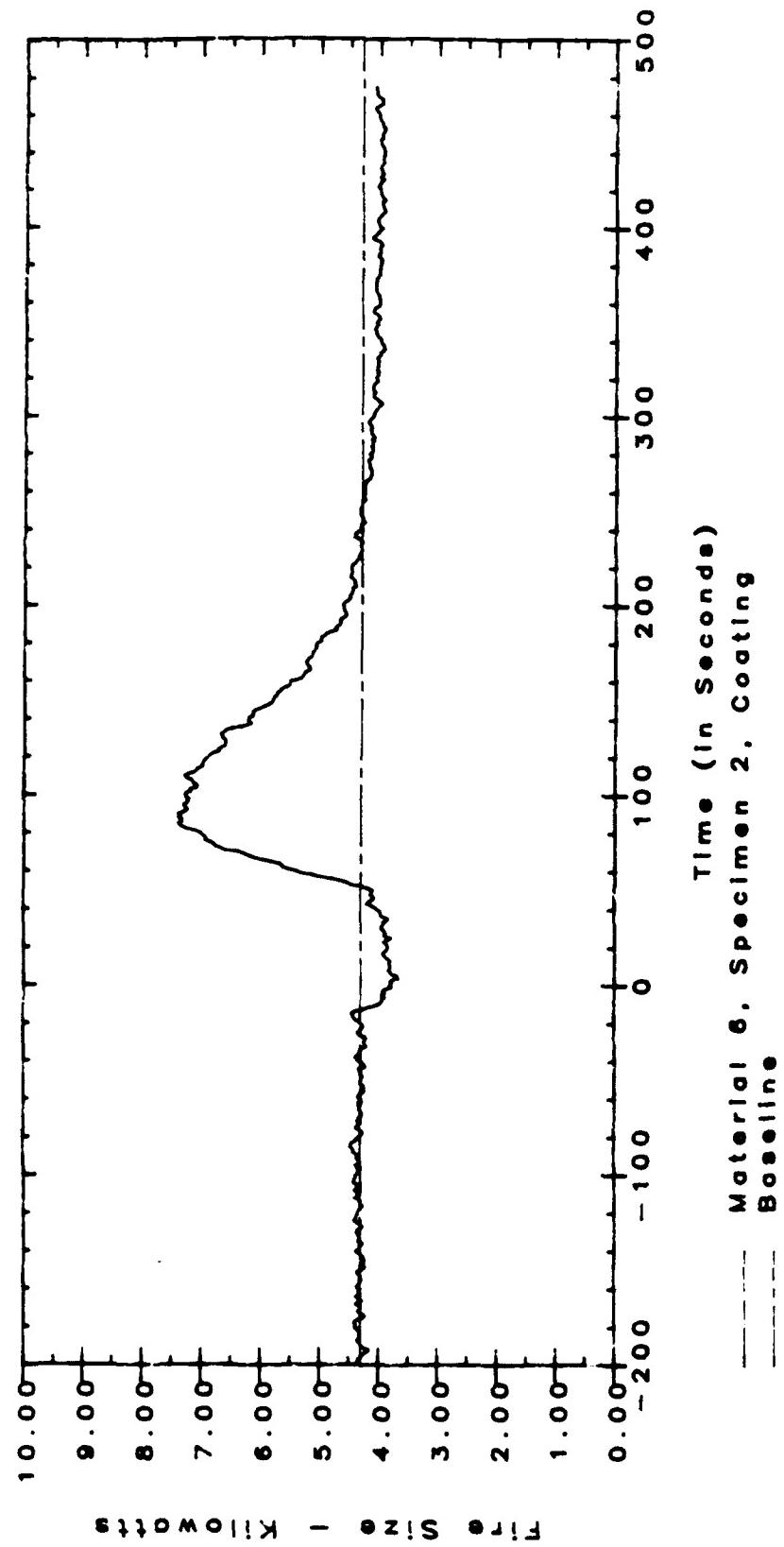
Time (sec)	Distance (mm)	Remarks
14-20	up to 350	Spontaneous bubbles up to 250mm, small bubbles up to 300mm
22-25	50-100	Black char at 50mm, 100mm, moderate to heavy smoke
30	400	Surface bubbles increased to 400mm no flaming
38	150	Complete black char
45		Heavy black smoke, surface bubbles about 2" dia.
50-60	100	Intermittent flames about 4" into stack above center line
65	300	Moderate smoke, black char
70-75	150	Flames progressed to 150mm across specimen, flickering inter- mittent but steady
85-105	200	Flames progressed to 200mm, inter- mittent-air escaping from bubbles causing flames to flare up and down
110	100	Flames have ceased
115	100-250	Intermittent flames, flickering on and off, 5" into stack
125		Pyrometer 3.92mv
135	400	Black char line above center line
140	350	Black char line below center line
145	550	Bubbles across specimen 1-2" dia.
150-160	250-300	Still have flaming, intermittent with air escaping from behind bubbles
165		Light smoke
170		No flame spread
175		Pyrometer 3.93mv
195	275	All flaming has ceased, left black char line on surface
215	275-425	Another black char line across speci- men
220	425-450	Char on top of surface bubbles
230	450-600	Surface bubbles across specimen
245	0-200	Complete white char
255	200-275	Black char where flame ceased
265	275-425	Black char line across specimen increased up to 450

TEST: M6S2SP2 Specimen Number 2 (cont'd)  
DATE: 21 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
285	450-600	Bubbles across specimen above and below center line, light smoke
295		Pyrometer 3.92mv
375		Final appearance, pyrometer 3.92mv
400	0-250	Specimen alligated with white char
430	275-425	Light black char line
445	425-650	Surface bubbles across specimen
465		No further progress on specimen, test complete

IMO FLAME SPREAD TEST



B-2.153

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TEST: M6S3SP2 Specimen Number 3

DATE: 27 July 1987

MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

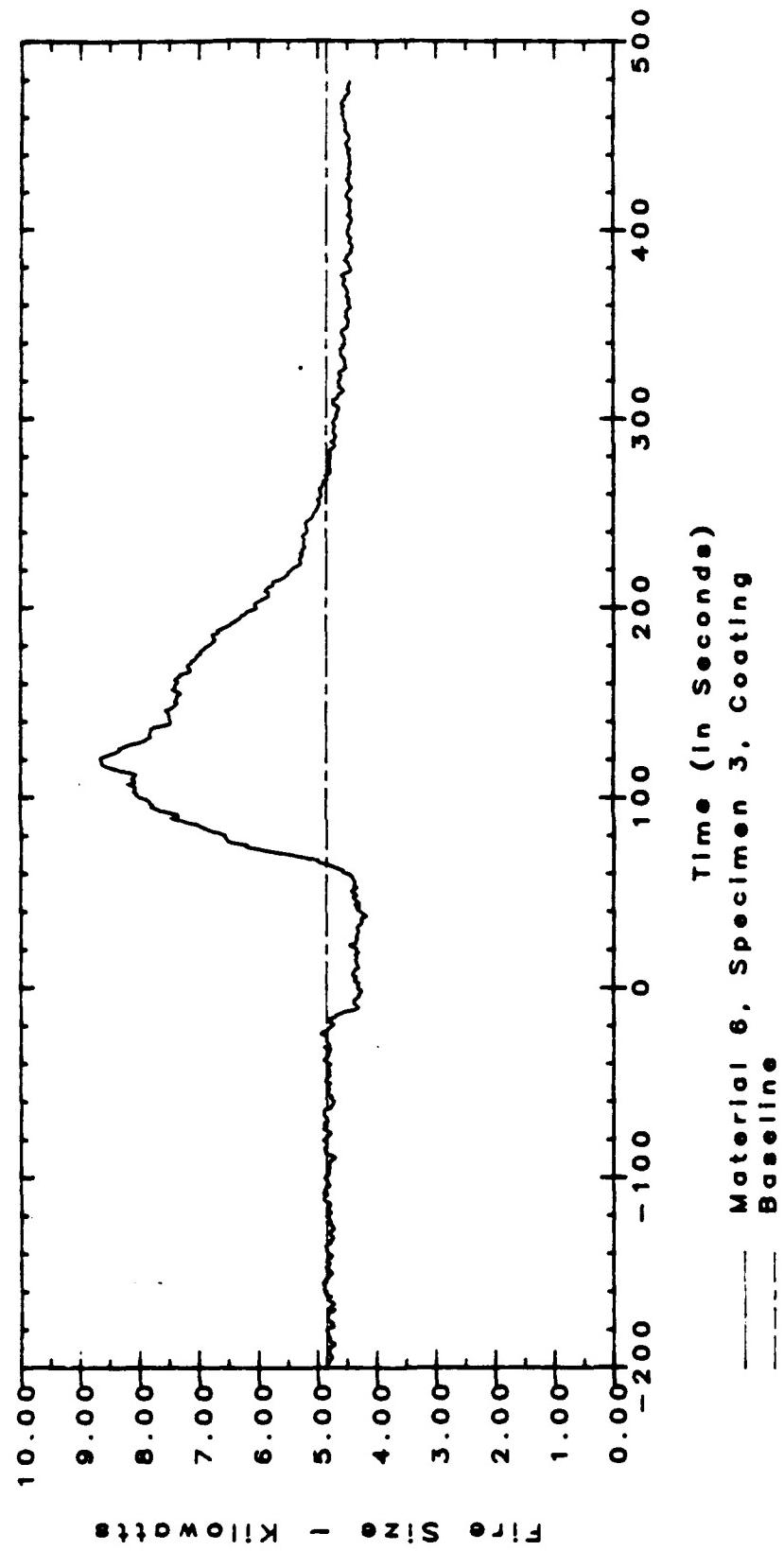
Time (sec)	Distance (mm)	Remarks
15-25	up to 300	Spontaneous bubbles up to 250mm, 300mm 1/8" dia. across specimen above and below center line
28	0-50	Starting to char, moderate smoke
35		Pyrometer 3.78mv
38	200	Progression of char
40	400	Progression of bubbles
45		Heavy smoke, no flames
70	0-100	Intermittent flames
80-90	0-100	Flames are steady, air escaping through bubbles, energizing flame, heavy smoke
92-95	200	Progression of flames, steady to intermittent across the specimen
100	500	Progression of bubbles above and below center line
105	350	Progression of char line
110	200-400	A large bubble formed the width of the specimen
115		Flames are steady about 4" into stack, moderate smoke
125		Flames are flickering from air escaping from bubbles
130		Pyrometer 3.93mv
145	0-100	Flames have ceased, material turning to white char
152	100-350	Flames are still going into stack about 6" (height)
165	550	Progression of bubbles
170	375	Progression of char line
185	100-250	Flames have ceased
190-197	250-300	Flames across specimen above and below center line, decreasing about 3" height into stack
205-220	100-475	Complete black char
230-250	350	Flame progression very light, decreasing flame is flickering intermittent, ready to cease, leaving a soot on the specimen surface

TEST: M6S3SP2 Specimen Number 3 (cont'd)  
DATE: 27 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
253		Smoke is light
260		Flames are intermittent, flickering on and off
310		Pyrometer 3.98mv
317-325	350	All flames have ceased on specimen, the dart soot mark is the flame spread distance
330	350-450	Dark brown char line
335-345	450-600	Bubbles across specimen above and below center line, very light smoke
405		Pyrometer 3.97mv
415	0-250	Material is white char, alligatoring
425-432	250-350	Material is black char with black soot at 350mm which is flame spread distance
435	350-450	Dark brown char line
445-450	450-600	Small bubbles across specimen above and below center line
445	350	Once again we had a flame spread distance of 350mm, test secured
405	550	Bubbles above and below center line
410	0-250	No material on specimen, just fell off
430	250-350	Black with char, no other changes in specimen
445		Pyrometer 3.96mv, test secured

IMO FLAME SPREAD TEST



B-2.157

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B-2.158

TEST: M6S4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: Coating

'JSCG - IMO SURFACE FLAMMABILITY TEST

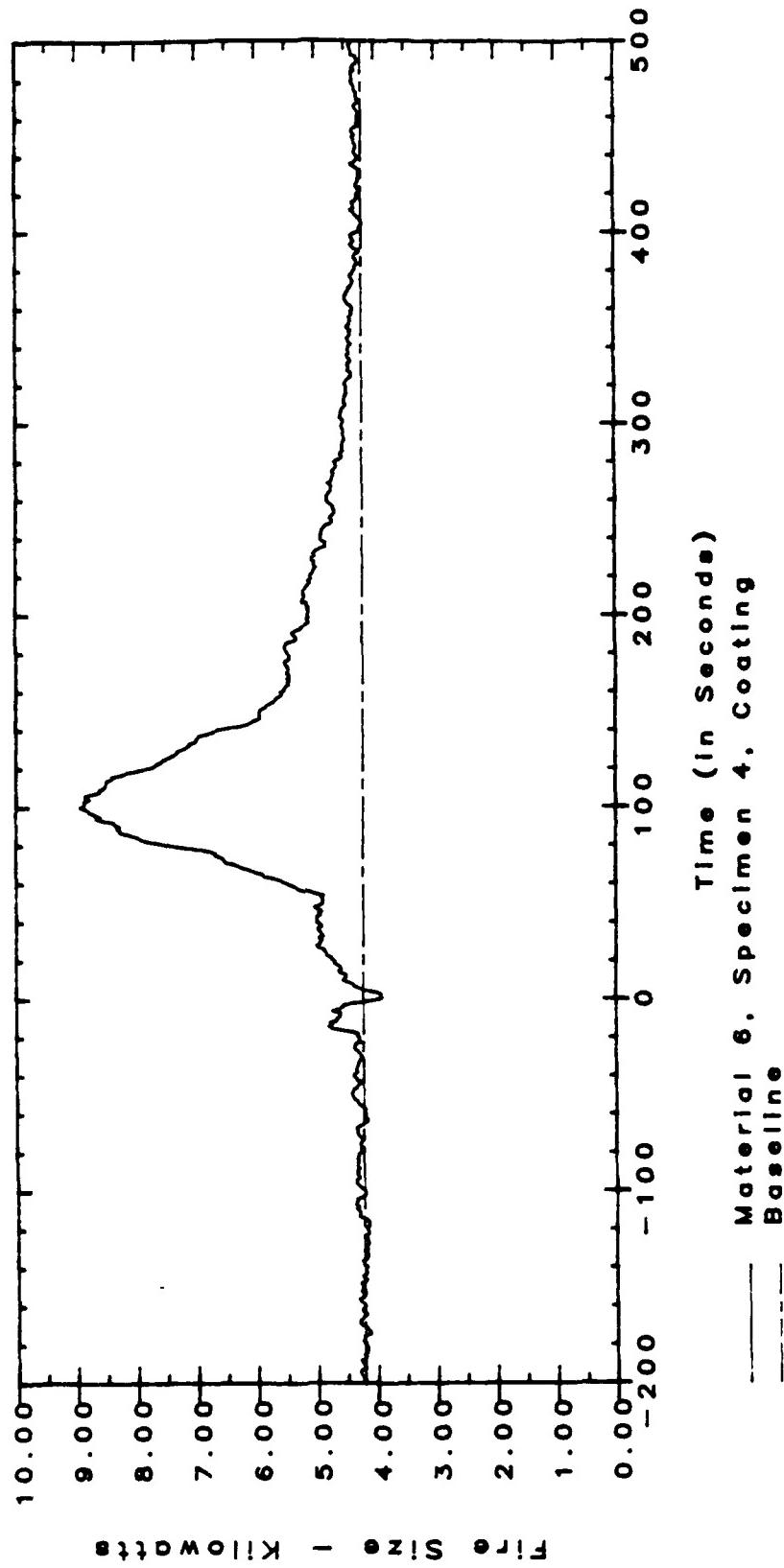
Time (sec)	Distance (mm)	Remarks
9	up to 50	Spontaneous char
12-22	up to 300	Spontaneous bubbles up to 250mm, 300mm, large bubble formed on surface, then collapsed, moderate smoke
30	400	Progression of bubbles, heavy smoke
35	200	Progression of black char above center line
45	250	Heavy smoke, black char across specimen above and below center line
55	450	Bubbles across specimen above and below center line
62-75		Heavy black smoke, intermittent flame on top of specimen holder, air escaping from bubbles energizing flame
80	0-150	Intermittent flames across specimen above and below center line, heavy black smoke
85		Flames steady now about 6" height into stack
92		Pyrometer 3.88mv
105-125		Flames are intermittent gaseous air escaping from bubbles causing unstable flames, you can smell the gaseous air
130	0-200	Intermittent flames have ceased
140	200-250	Steady flame about 2" off surface into stack, black soot, heavy black smoke
165	0-200	Complete black char with material separating or top of specimen holder
175	525	Bubbles across specimen above and below center line
185	400	Complete black char above and below center line
195-212	250-325	Small area of flame diagonal across specimen, on and off, 3" height into stack, moderate smoke
220	0-250	Material white char

TEST: M6S4SP2 Specimen Number 4 (cont'd)  
DATE: 29 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
225	0-300	Material separating from specimen along top by holder
230		Pyrometer 3.98mv
255	300-350	Small intermittent flame leaving black soot on specimen
265	300-350	Flame ceased below center line
270-305	350	All flames have ceased, light smoke, flame left residue of soot on specimen, becoming a flame spread distance at intersection of center line at 350
310	450	Dark brown char line
315	550	Small size bubbles across specimen above and below center line
330	0-250	Complete white char
335		Pyrometer 3.98mv
430		Pyrometer 3.97mv
440	0-250	Complete white char
448	250-350	Black soot, flame spread distance
455	350-450	Dark brown char
460	450-550	Small bubbles across specimen
470-490	0-400	Material has separated along top of specimen holder 1/2" off backing, test complete

IMO FLAME SPREAD TEST



B-2.161

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B-2.162

TEST: M6S5SP2 Specimen Number 5

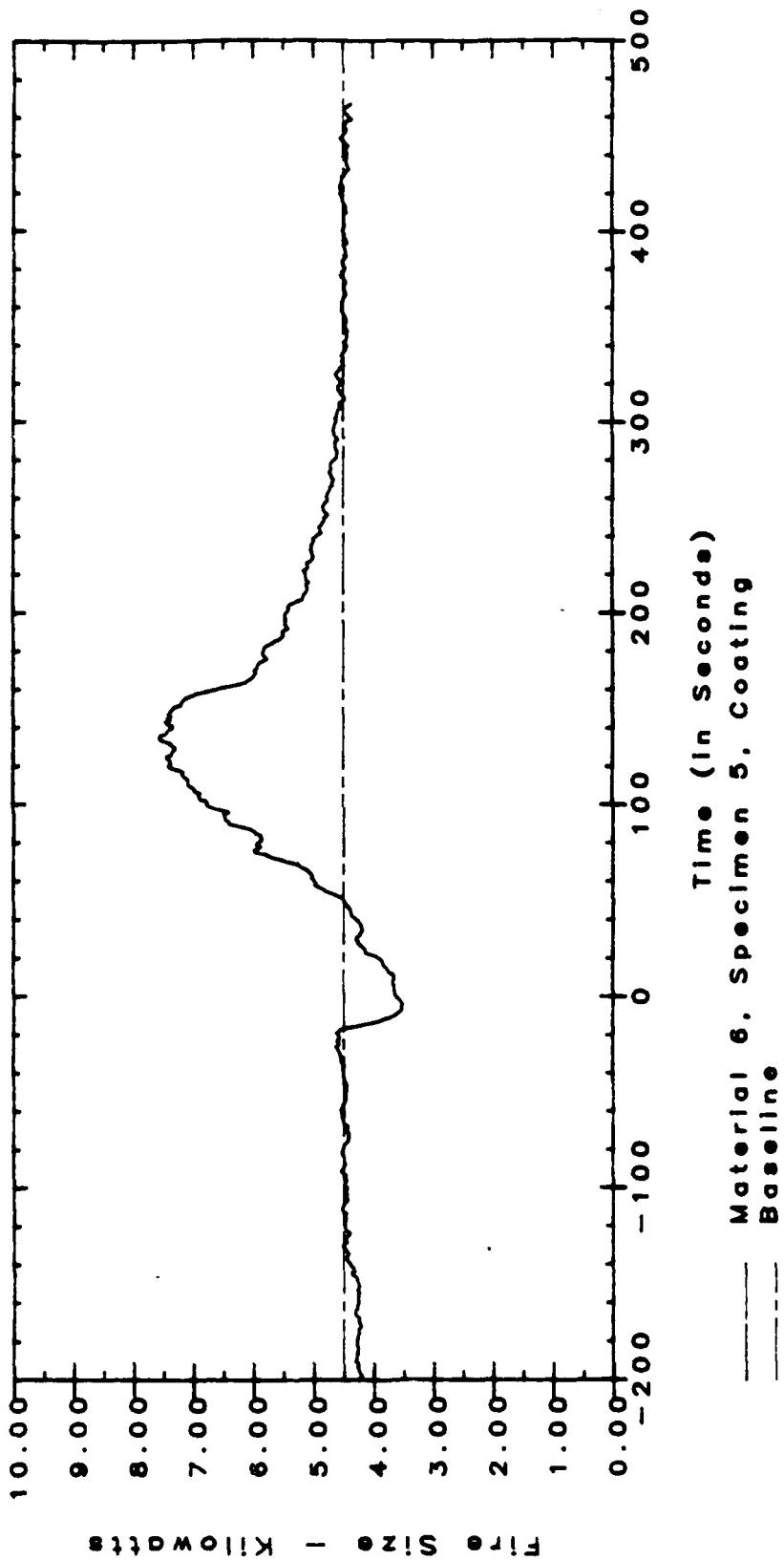
DATE: 30 July 1987

MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
15	up to 300	Spontaneous bubbles
25	0-200	Intermittent flames
28	0-150	Black charring and heavy black smoke
40		Intermittent flames have ceased
45	200	Complete black char
50	400	Bubbles across specimen
60	0-10	Flaming coming from behind specimen backing
75	0-50	Material starting to separate, crack
85-90	0-100	Flames steady in progression up to 150mm about 6" into stack, orange in color
105	0-50	An escaping energizing flame at this position above center line
130	50-250	Flames above and below center line energized from escaping air from behind bubble
145	0-200	All flames have ceased
155	200-250	Flames are about 6" into stack
170	0-250	All flames ceased
178	250-300	Flames decreasing leaving a black soot line on specimen, flames about 1" high
215	300	Flames have ceased leaving at black soot line at 300mm, this is flame spread distance
227	300-400	Complete black char line
235	400-550	Bubbles across specimen
240	0-200	Cracked above center line and turning to white char
305	100	Small intermittent flame on top of specimen by pilot flame
395		All flames have ceased, no more smoke
405	0-250	Complete white char with surface crack about 1" below holder
432	250-300	Black soot line, also flame spread
442	300-450	Complete black char
450		Bubbles above and below center line
460		Pyrometer 3.90mv, test complete

IMO FLAME SPREAD TEST



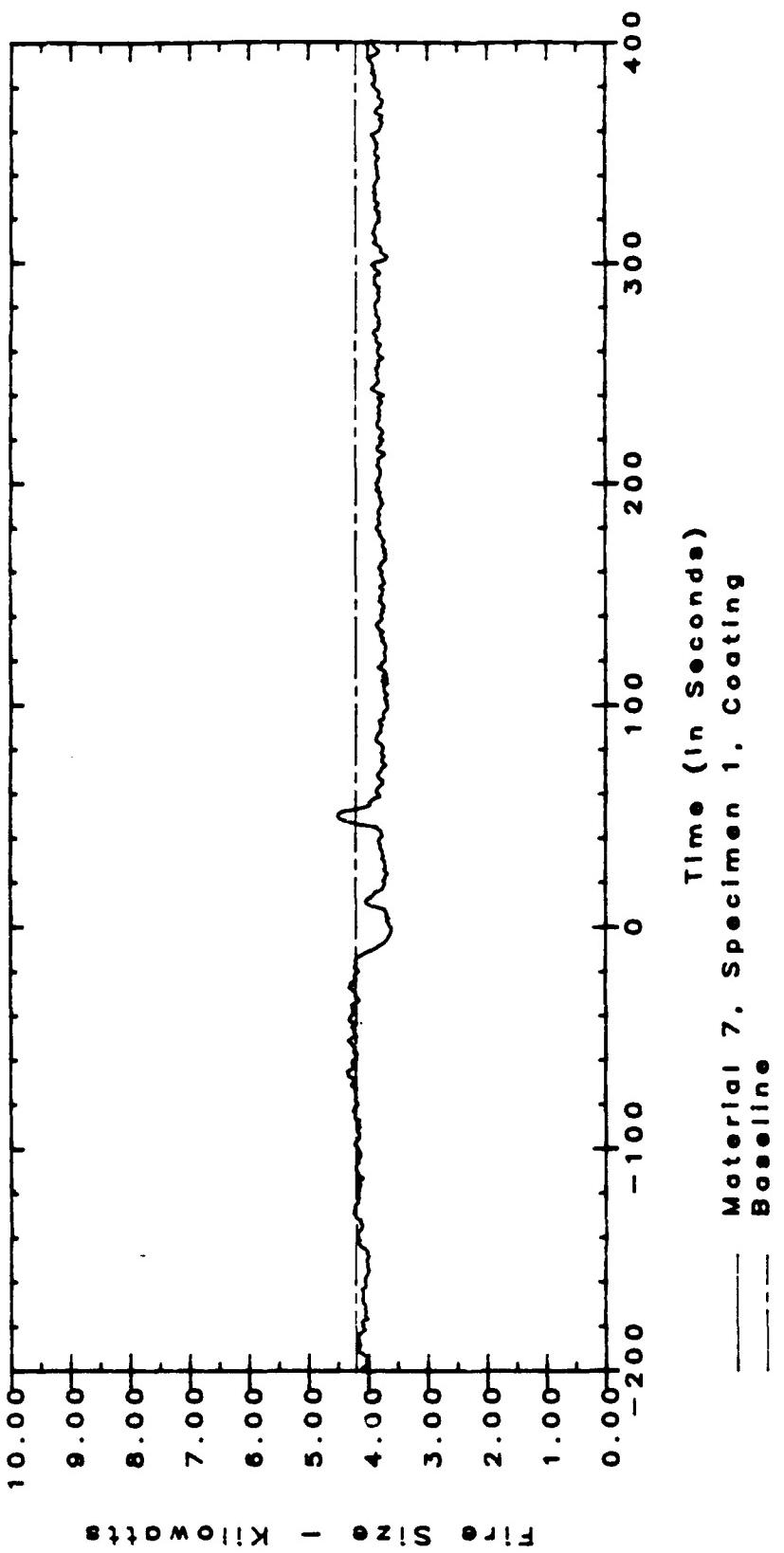
B-2.164

TEST: M7S1SP2 Specimen Number 1  
DATE: 17 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
6	200-250	Spontaneous charring across the surface
12	0-50	Intermittent flames, at 0-50mm, flames out
20	300	Black char
27	350	Light smoke, black char
45	400	Black char, intermittent flames
65		Sample material is intact with specimen backing
75	0-50	No bubbles on material, turning white char
85	450	Black char line up to 450mm, light smoke
90		Pyrometer 3.80mv
115	450	Light smoke, char line
128	0-100	Material white char, above centerline
230	500-550	Black char line, bubbles at 550mm, 2" in size with some light charring on bubble surface
255	200	White char line
260		Pyrometer 3.87mv 260
275		No smoke
330	0-200	White char line
335	200-500	Black char
342	525-550	Bubbles on surface with light char on surface
354	550-575	Same bubble, no char
390		Test complete

IMO FLAME SPREAD TEST



TEST: M7S2SP2 Specimen Number 2

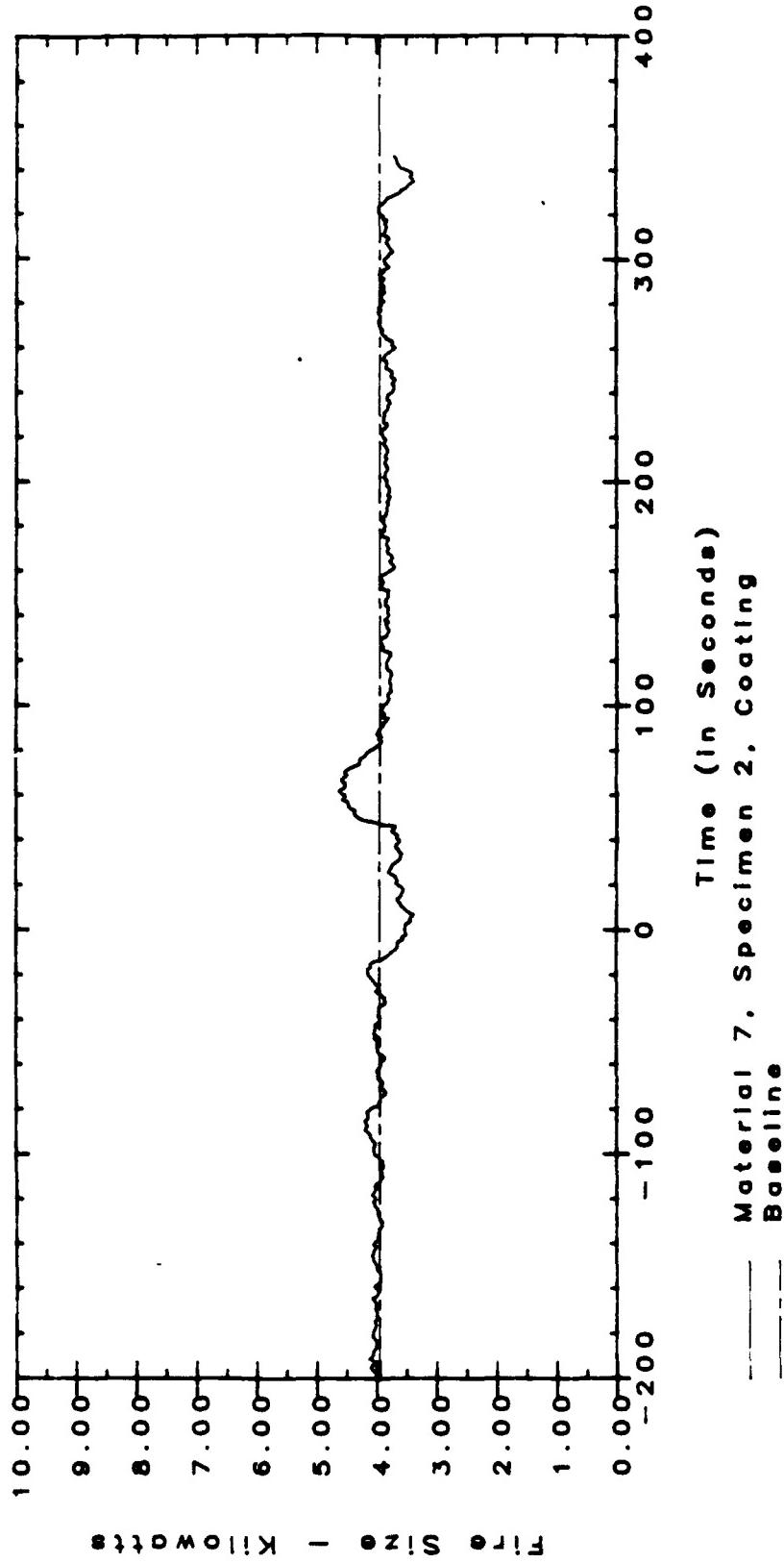
DATE: 20 July 1987

MATERIAL: Coating

USCG -IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5	up to 300	Spontaneous char up to 200-250mm, char 300mm
10	100	Heavy smoke, no flames
17	450	Bubbles on surface, charring
25	350	Char line
30	300	Heavy black smoke, surface material not burning, just charring
38		Pyrometer 3.79mv
45	400	Dark char line
50		Intermittent flames on top of specimen header, no material burning at this time
60		Light smoke
75	600	Bubbles
80	450	Char line, light brown color
90-115		No flames, no flame spread, material has netting and appears to be separating from original backing
120	0-150	White char
126		Pyrometer 3.84mv
135		Very light smoke
155		No progression of material
170		Pyrometer 3.85mv
230		Pyrometer 3.86mv
240		No progression of material
250	0-200	White char
255	200-500	Light brown char
265	525	Dark brown char line
270	525-600	Light bubbles on surface
315		Pyrometer 3.89

IMO FLAME SPREAD TEST

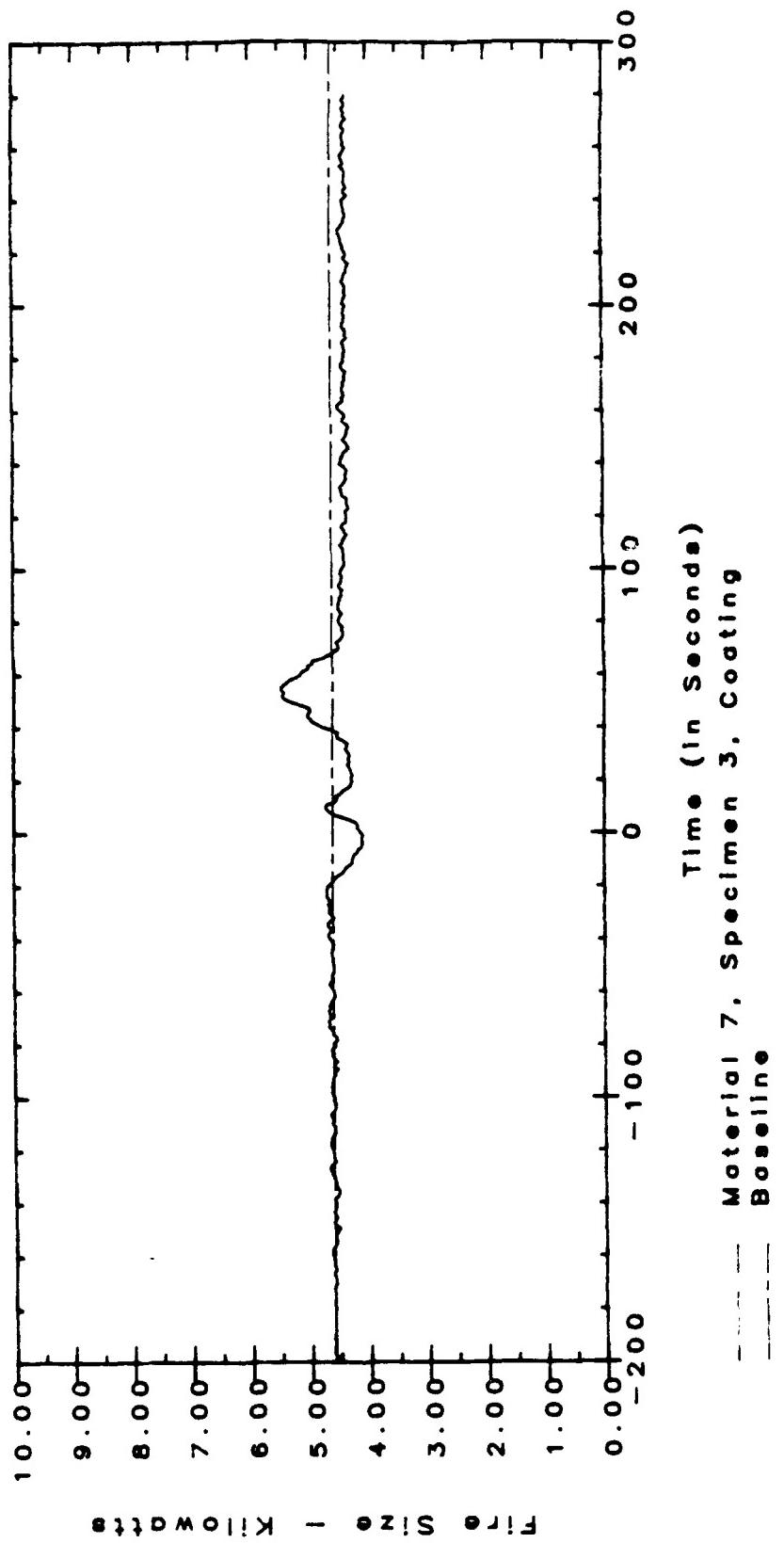


TEST: M7S3SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7	up to 300	Spontaneous charring
10		Intermittent flames
13-15		Intermittent flames are out, moderate smoke
25	350	Charring across specimen above and below center line
30		Pyrometer 3.85mv
40-50	0-100	Intermittent flames across specimen no constant burning
55	400	Progression of char line
60-65	0-100	Intermittent flames still flickering this type of material is a netting
68		Intermittent flames have ceased
71		Moderate smoke
85		No action on this test
105		Pyrometer 3.90mv
110		Light smoke
115	0-200	Material turning white with char above and below center line
120	200-450	Dark brown char line across specimen above and below center line
130	450-750	No change on specimen, no bubbles
215		All smoke has ceased, pyrometer 3.94mv
235	0-200	Specimen turning white char above and below center line
240	200-500	Dark brown char, vertical across the surface of the specimen
250	500-750	No change in specimen, appears to be normal
265		Pyrometer 3.95mv, no smoke, no flames, test secured

IMO FLAME SPREAD TEST

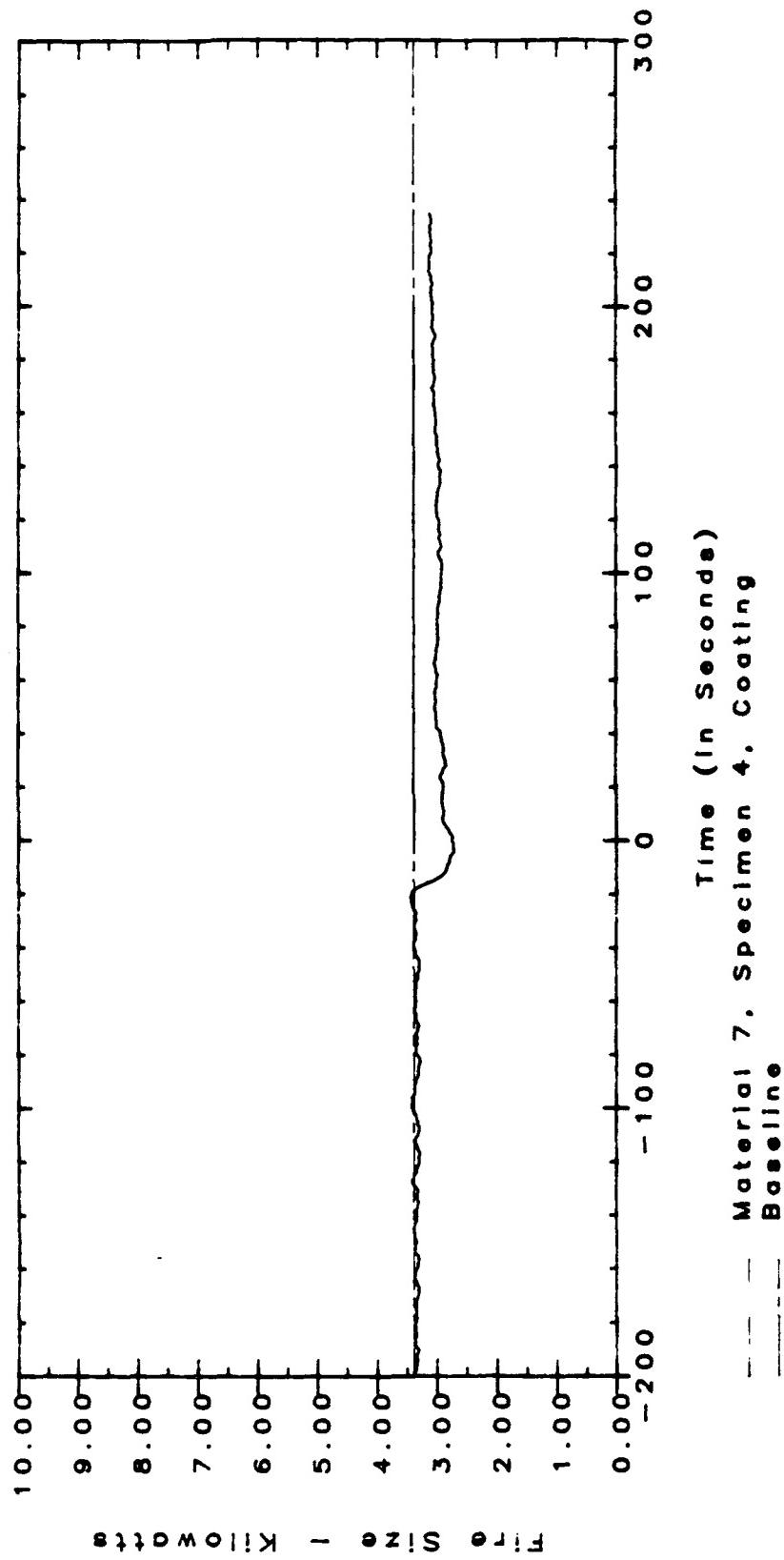


TEST: M7S4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8-15	up to 350	Spontaneous smoke and char across specimen above and below center line
20-30		Moderate smoke, impinging pilot flame went out, continue to run test
48	400	Moderate smoke and char across specimen above and below center line
105	450	Complete light char across specimen, light smoke, no flames
115		Pyrometer 3.91mv, no pilot flame
150	300-450	Surface bubbles starting to form below the netting
200		Pyrometer 3.91mv
210	0-200	Material turning to white char across specimen
215	200-500	Complete brown char line
220	300-500	Bubbles on the surface behind the netting
230		Pilot flame went out at the beginning of the test, test complete

IMO FLAME SPREAD TEST



TEST: M7S5SP2 Specimen Number 5

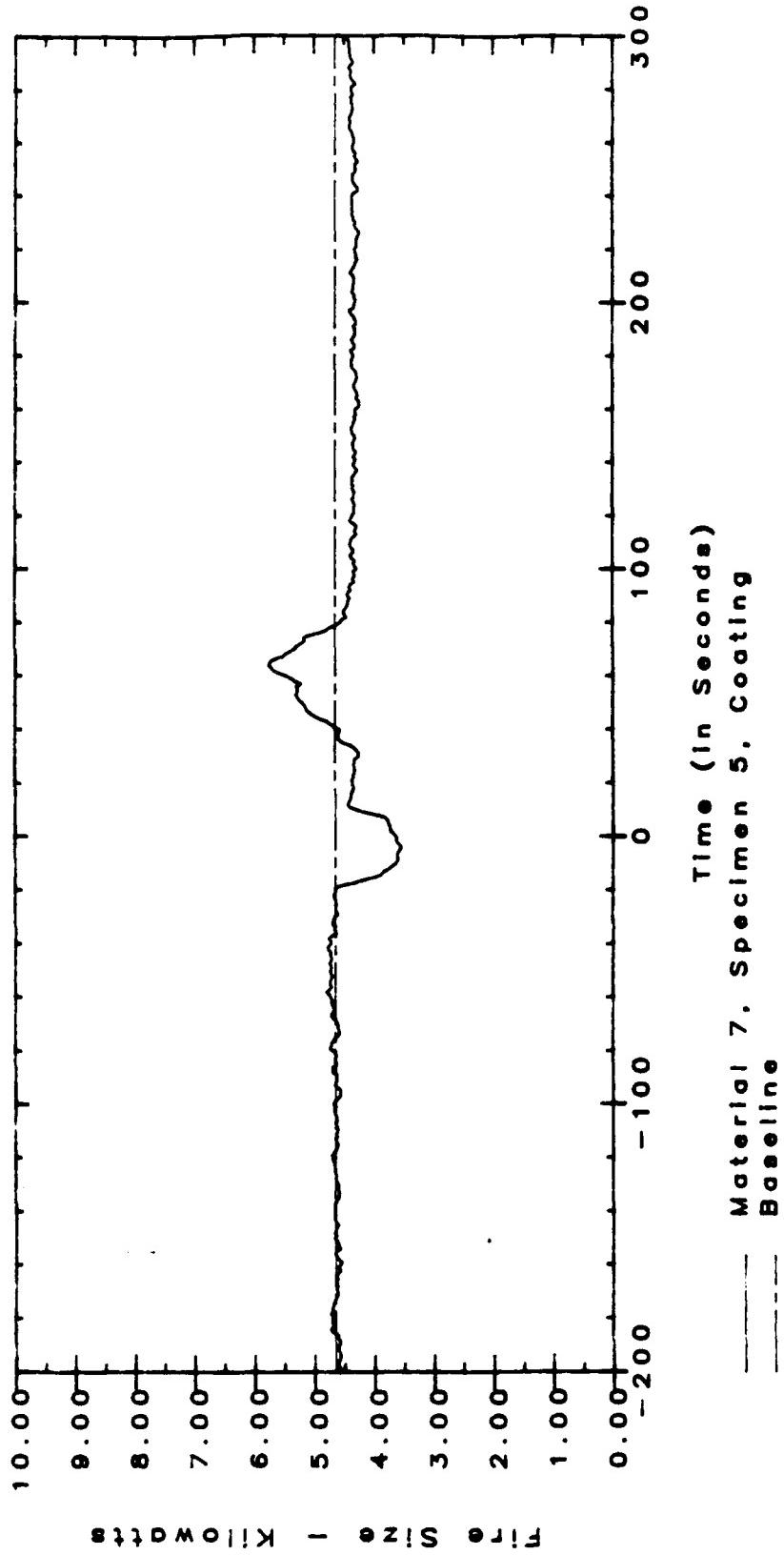
DATE: 30 July 1987

MATERIAL: Coating

USCG -IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10	up to 300	Spontaneous char
25	350	Char across specimen above and below center line
60	0-200	Intermittent flames above the center line 2" into stack when lit
80	0-250	Intermittent flames have ceased
95	0-450	Complete black char across specimen, light smoke
105	450-500	One large bubble on surface
110		Pyrometer 3.78mv
270		Pyrometer 3.85mv
280	0-250	Completely charred white
285	250-525	Complete light brown char
300	525-750	No change in specimen
305		Test complete

IMO FLAME SPREAD TEST



B-2.174

TEST: M8S1SP2 Specimen Number 1

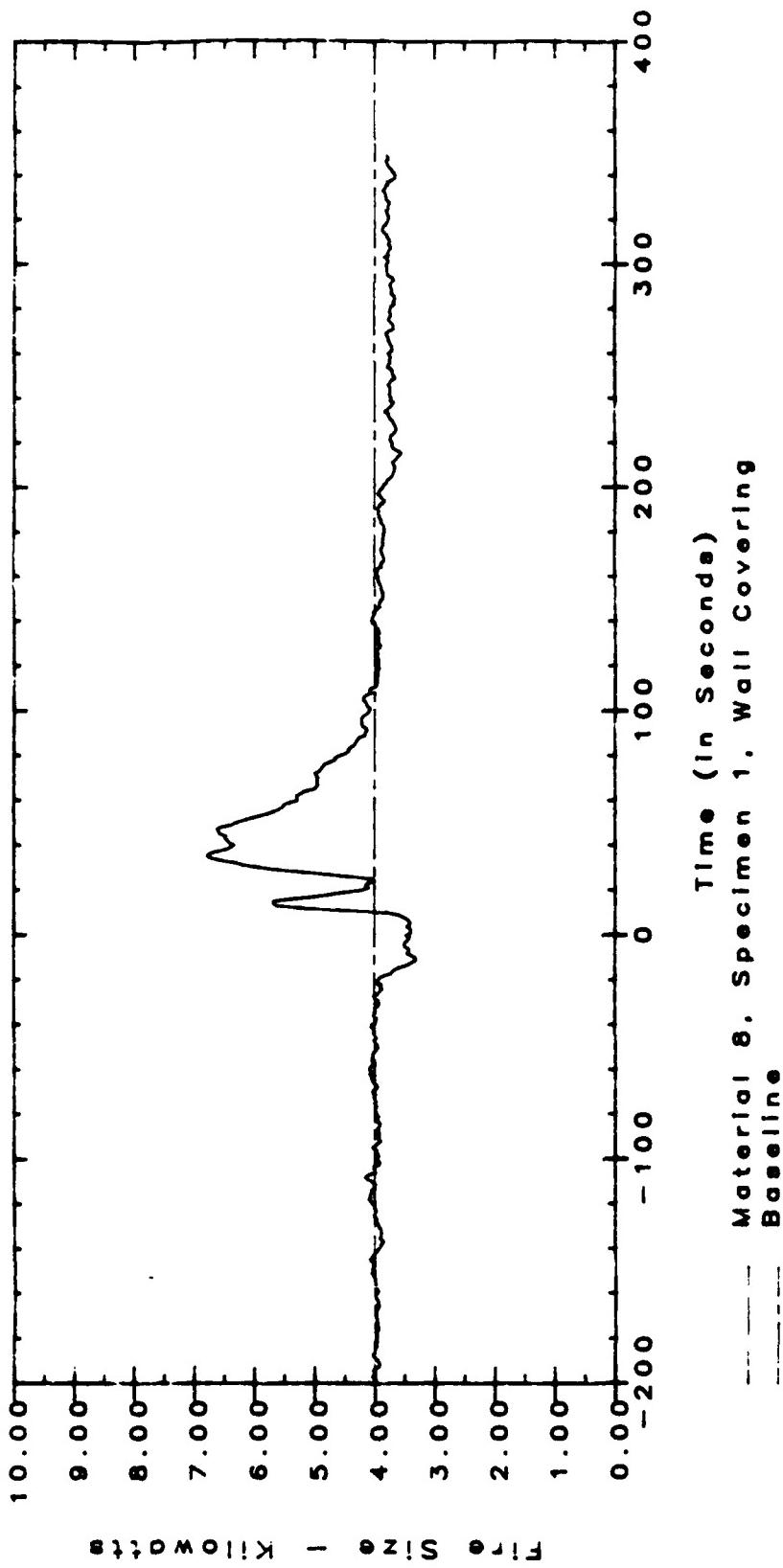
DATE: 20 July 1987

MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7	300	Spontaneous bubbles across surface
14	300	Intermittent flaming across surface
18		Flaming has ceased
20		Heavy black char, surface alligated
25	450	Bubbles
30-40	0-250	Flames started again across surface 6-8" into stack
45		Pyrometer 3.85mv
55	up to 300	Intermittent flames now
60	100-300	Flames decreasing rapidly
70-80	0-350	Flames out, 0-350mm complete black char and surface alligated
90	550	Bubbles increased across surface
95	350	Small flame at 350mm above center line
100		Light smoke
105		Material is attached to original backing
110		No flame spread, light smoke
140		Pyrometer 3.88mv
155	350	Material did separate at 350mm, vertical across the surface
165	0-150	Complete white char
170	150-350	Black char
175	350-400	Material separated from specimen
183	400-450	Black char
190	450-600	Bubbles across surface
195	600-700	Bubbles above center line
215		Pyrometer 3.90mv
260		Very light smoke
265		Pyrometer 3.89mv
275	0-250	Complete white char
285	250-350	Black char across surface
290	350-400	Material separated from specimen
295	400-450	Black char across surface
315	450-600	Bubbles across surface
322	600-700	Bubbles above center line
330		No smoke, no flame, test secured

IMO FLAME SPREAD TEST



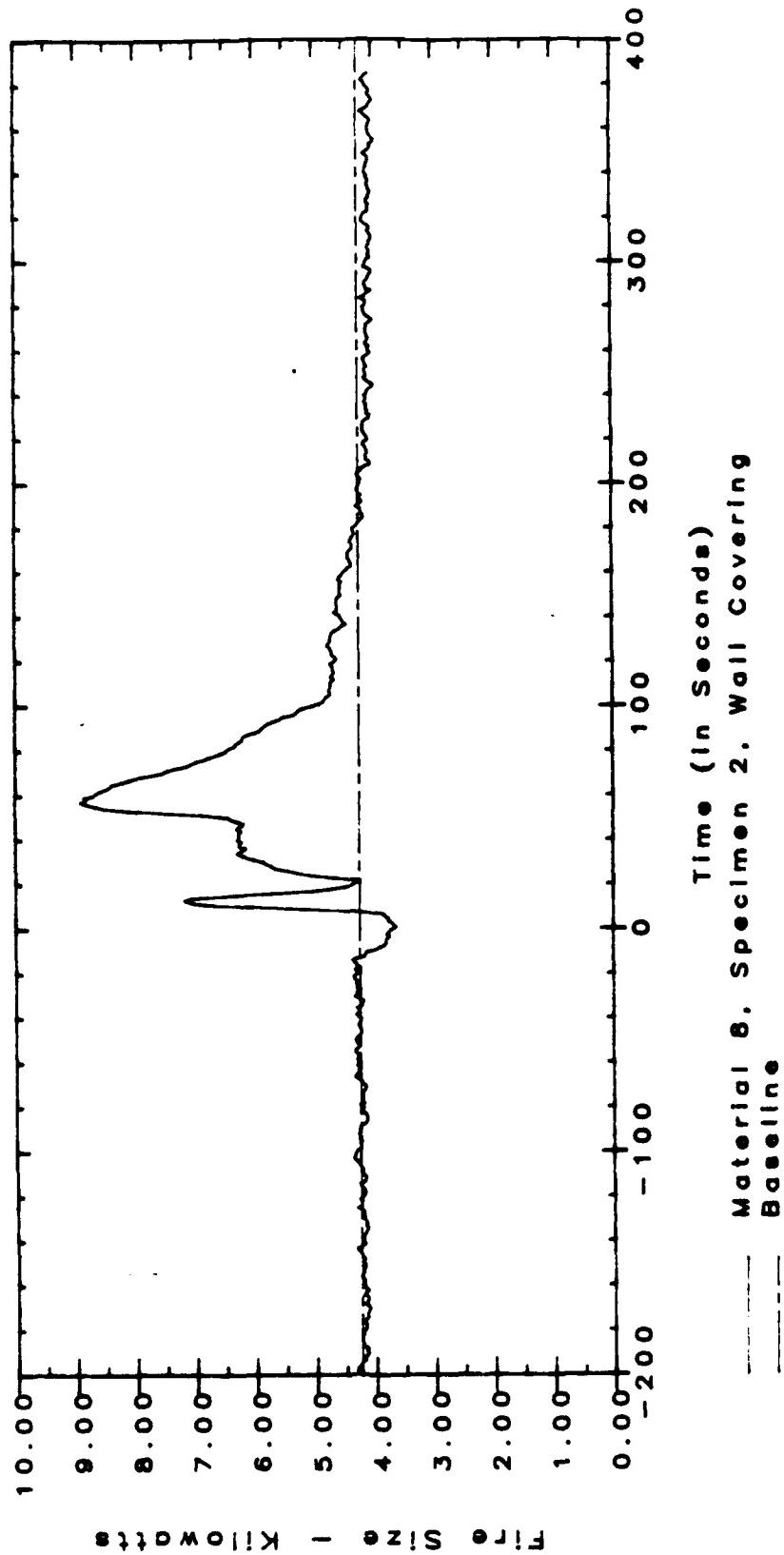
B-2.176

TEST: M8S2SP2 Specimen Number 2  
DATE: 21 July 1987  
MATERIAL: Wallcovering

USCG -IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7	up to 400	Spontaneous bubbles across specimen
12	up to 200	Flaming across specimen
15		Flaming has ceased, out
18-25	up to 500	Moderate to heavy smoke, bubbles
30-35	0-250	Surface is alligatored, light smoke
40		Pyrometer 3.79mv
55-65	up to 350	Flames across specimen 6-8" in stack
80	0-200	Flames ceased
85	200-300	Intermittent flames, flickering, about 3" in height
95		Flaming is out on specimen and holder, light smoke
110	550	Bubbles increase to 550mm across specimen
115	up to 400	Dark char
125	100	Material has separated from specimen and starting to flake off
135		Light smoke
140	up to 350	Alligatoring across specimen
180	400	Dark char line
188	400-600	Bubbles across specimen
195	0-100	Material has fallen off specimen
200		Very light smoke
205		Pyrometer 3.88mv
280		Pyrometer 3.87mv
285		No further progression on specimen
290	0-150	Material has flaked off specimen
298	150-250	White char and surface alligatored, separated
312	250-450	Dark black char and surface alligatored
330-350	450-700	Light surface bubbles across specimen with a large bubble at 650-700mm, 2" in dia., 1" off surface above center line
365		Pyrometer 3.91mv, test complete

IMO FLAME SPREAD TEST

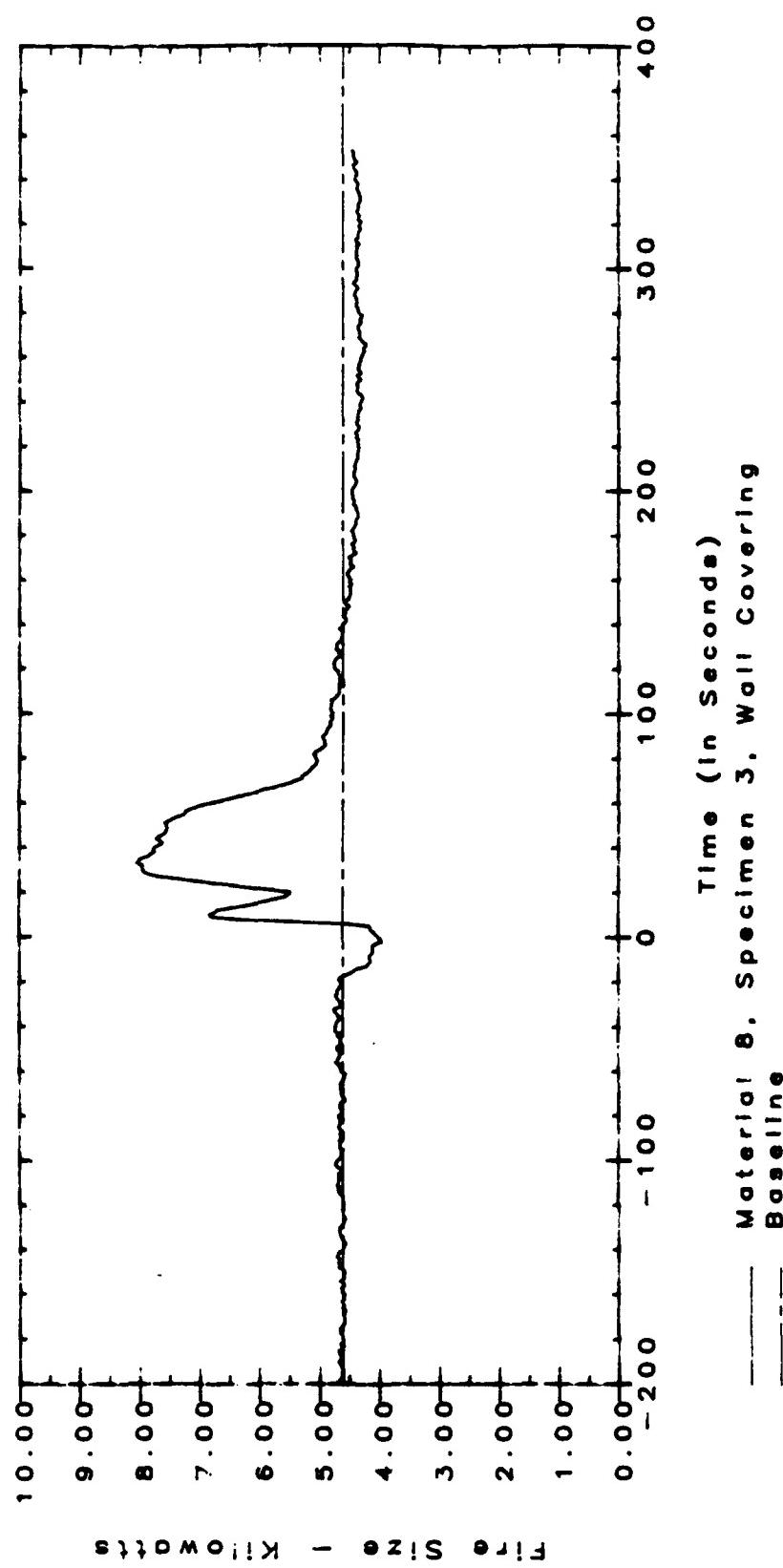


TEST: M8S3SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5	up to 400	Spontaneous bubbles
10	up to 200	Spontaneous flames across specimen
15		Intermittent flames have ceased, out
20-25	200	Heavy black smoke, intermittent flames have started again across specimen above and below center line
30	450	Progression of bubbles
33-43	250-350	Flames are going constantly across the specimen above and below center line, about 6" (height) into stack, up to 300mm now
45		Pyrometer 3.89mv
55		Flames are now intermittent,
63		Flames have ceased
70		Moderate smoke
80	300	Black char line across specimen
85	350	Light char line across specimen
95	600	Bubbles across specimen above and below center line
100	350	Complete surface is alligated
115		Light smoke, pyrometer 3.89mv
185		Pyrometer 3.91mv, very light smoke
200	0-250	Specimen is white char and alligated above and below center line
212	250-300	Dark brown char line across specimen
217	300-450	Light brown char across specimen, surface is alligated in char area
225	400-600	Bubbles across specimen above and below center line
233		No flames, light smoke
277		Pyrometer 3.92mv, no further activities on specimen
295	0-250	White char with alligated surface
303	250-300	Dark brown char and alligated surface
312	300-450	Light brown char and alligated surface
322	450-600	Bubbles across specimen above and below center line
330		Pyrometer 3.95mv, test secured

IMO FLAME SPREAD TEST



B-2.180

TEST: M8S4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

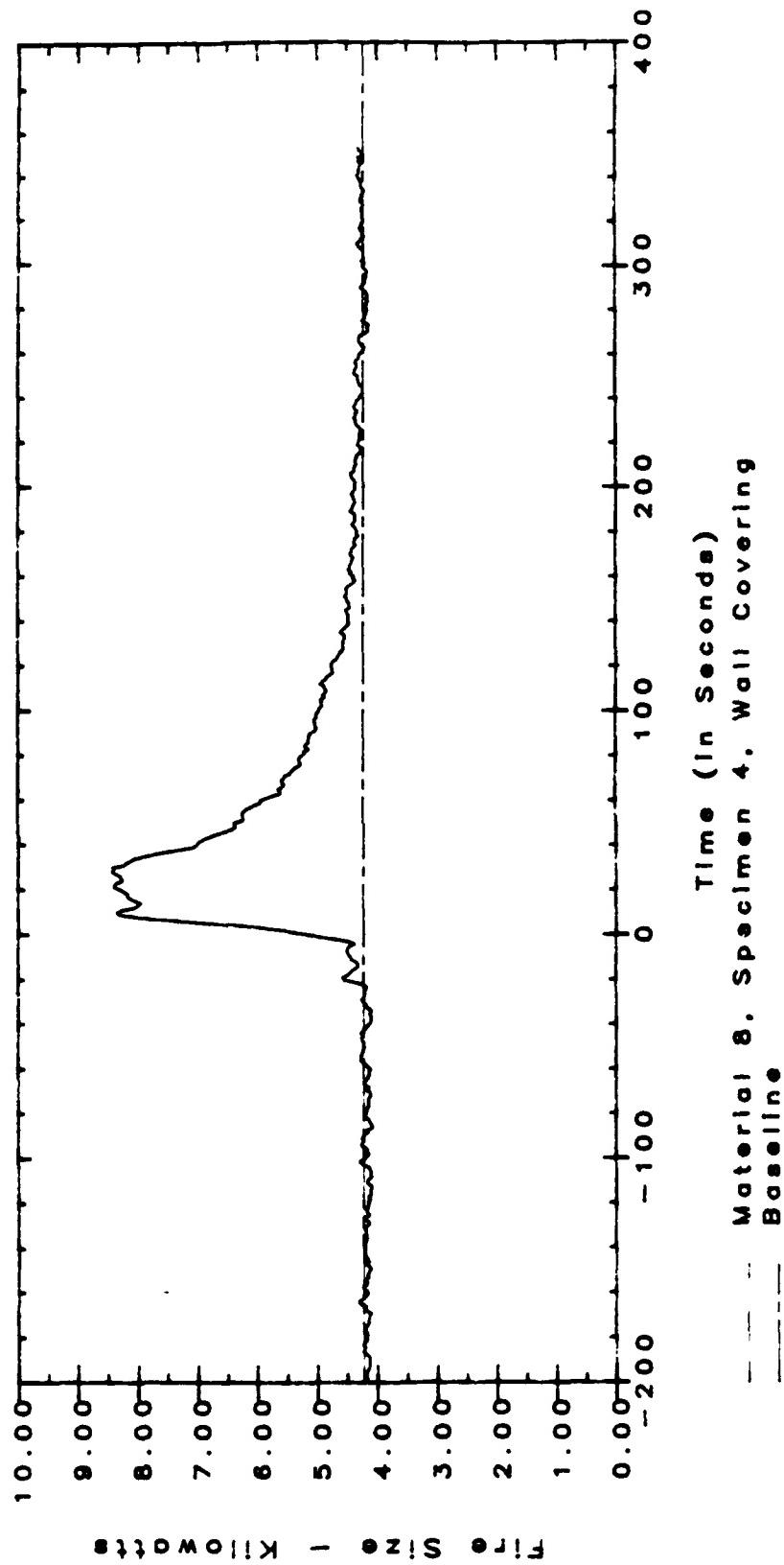
Time (sec)	Distance (mm)	Remarks
8	300	Spontaneous bubbles up to 300mm
12-18	up to 250	Spontaneous flames up to 250mm, steady to intermittent 6" (height) into stack
25	550	Bubbles across specimen above and below center line
32	250	Progression of flames steady and constant
38	300	Complete black char across specimen
45	0-200	Intermittent flames ceased
53	200-300	Steady flame decreasing to 4" (height) into stack
65		Pyrometer 3.87mv
80	0-300	All flames have ceased
90	300	Flame line going into stack 2" (height), orange color, moderate smoke
95		Flames are intermittent now
105	350	Intermittent flames have ceased below center line
125	550	Bubbles across specimen above and below center line, light smoke
130	350	Flames have ceased, probable flame spread
155	375	Flame intersect at center line forming flame spread distance, light smoke
175	0-200	Specimen is turning to white char, and alligated surface
185	200-375	Specimen is black char and alligated
196	375-500	Light brown char line, this subject material is brown in color
210	550	Bubbles across specimen above and below center line

TEST: M8S4SP2 Specimen Number 4 (cont'd)  
DATE: 29 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
220		Material did separate at the flame spread vertical line 1/4" wide crack
280		Pyrometer 3.91mv, all activities have ceased
295	0-250	Complete white char with alligatored surface
305-315	250-375	Complete black char with alligatored surface, also 1/4" wide crack vertical along flame spread mark
320	375-450	Complete light char line
330	450-575	Bubbles across specimen above and below center line
340		Pyrometer 3.92mv, test complete

IMO FLAME SPREAD TEST



B-2.183

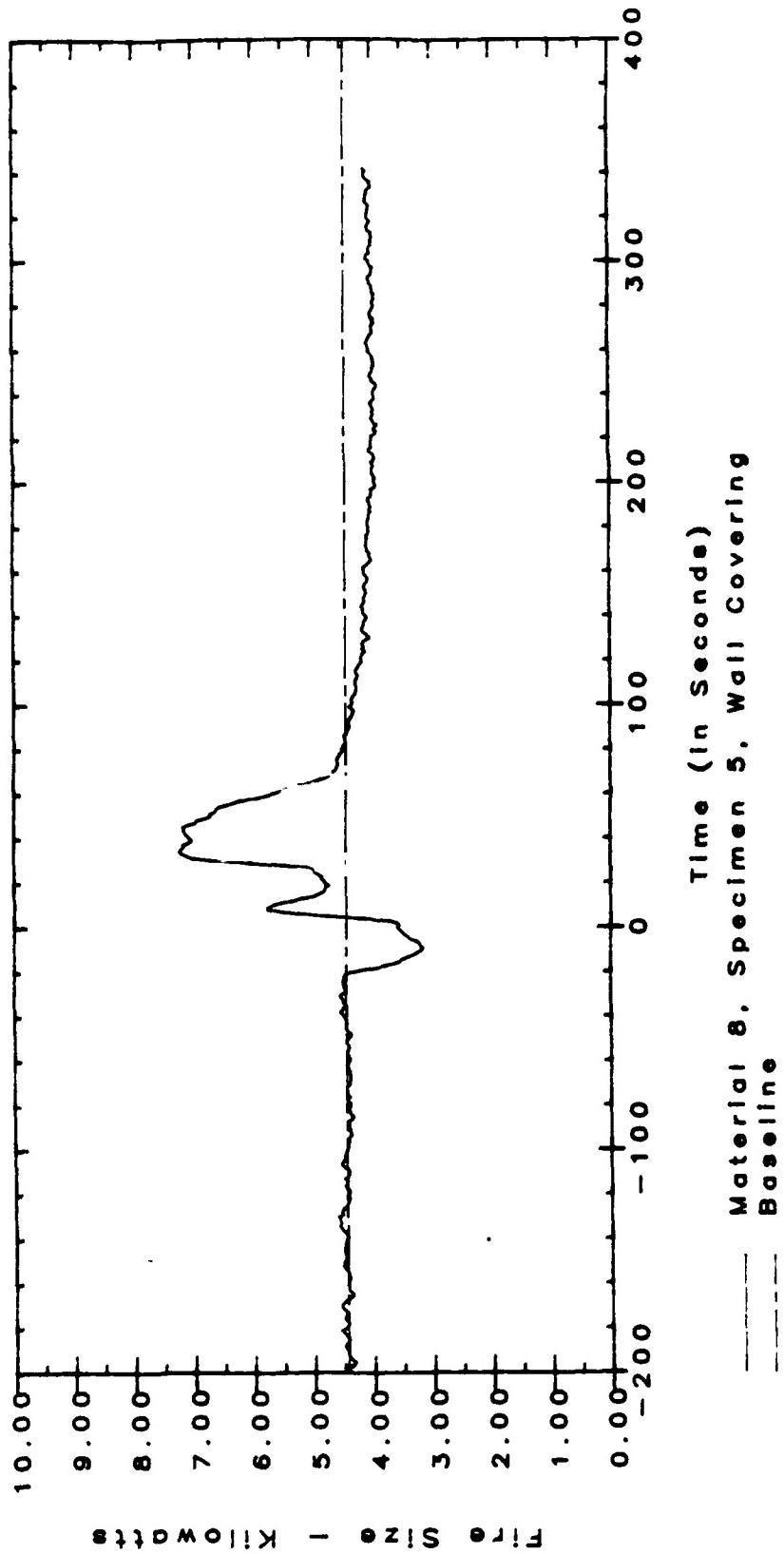
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TEST: M8S5SP2 Specimen Number 5  
DATE: 30 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5-15	200-500	Spontaneous bubbles and flames, flames to 200mm, bubbles to 500mm
18		Flames have ceased
22		Gases burning on top of holder by horizontal pilot
32-45	0-250	Intermittent flames across specimen with flame height of 6" into stack
55	550	Bubbles above and below center line
60		Still light smoke and intermittent flame
70-90	375	Flames have ceased, it appears we had a flame spread of 375mm, fast action
150		Flame spread mark on specimen has vertical surface crack about 1/8" wide
255		Pyrometer 3.86mv, no further activities
275	0-250	Complete light char and alligated surface
295-310	250-375	Complete black char and alligated surface with 1/8" surface crack at flame spread position
318	375-500	Another black char line
325	500-600	Bubbles across surface
335	600-700	Bubbles above center line
345		Pyrometer 3.86mv, test complete

IMO FLAME SPREAD TEST



B-2.186

TEST: M9S1SP2 Specimen Number 1  
DATE: 20 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7	up to 300	Spontaneous smoke
10	up to 150	Intermittent flames
15	200	Complete charring
20-30		Heavy dark char, alligatoring, intermittent flame
30-40	up to 150	Flaming stopped, then started up again across the surface. Constant flaming the width of the specimen then turning intermittent up to 150mm, moderate smoke, no flame spread
43		Flame has ceased
55	100-200	Intermittent flame
60	350	Complete black char across surface
65	350-400	Bubbles across surface
70	200-250	Intermittent flames across surface
80	200-250	Intermittent flames at 200-250mm above center line now
85		Flame is out
90	0-150	White char, material starting to separate from specimen backing
105		Pyrometer 3.87mv
124	400	Smoke decreased to 400mm light smoke
127	up to 200	Material has separated from specimen backing
140	350-400	Moderate smoke
147	400	Black char line
152	450	Bubbles up to 450mm
160	0-250	Material has separated from specimen backing and flaking off, turning white char
170		Moderate smoke, pyrometer 3.87mv
180	400	No evidence of further flaming, moderate smoke, char line has not progressed past 400mm
205	0-100	Material has flaked off specimen backing
210	100-250	Material has raised off specimen backing
247	450	Black char line
252	450-500	Small surface bubbles, very light smoke
300		Pyrometer 3.87mv
372	0-150	Material has fallen off sample

TEST: M9S1SP2 Specimen Number 1 (cont'd)

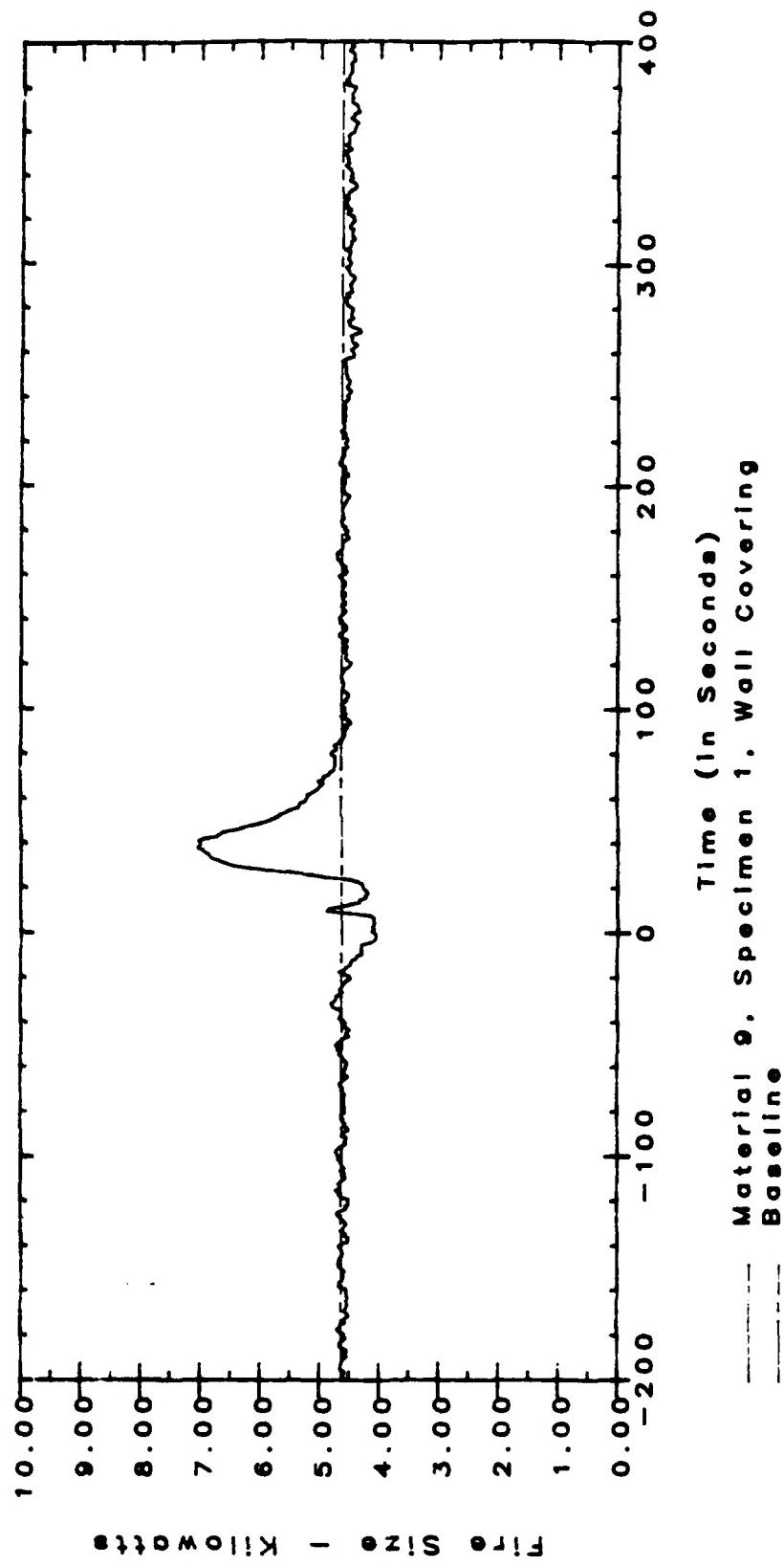
DATE: 20 July 1987

MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
380	150-250	Material is raised off specimen backing, has not fallen off, turning white char
390	250-450	Black char and alligatored
400	450-500	Small surface bubbles, slight smoke
405		Test complete

IMO FLAME SPREAD TEST



B-2.189

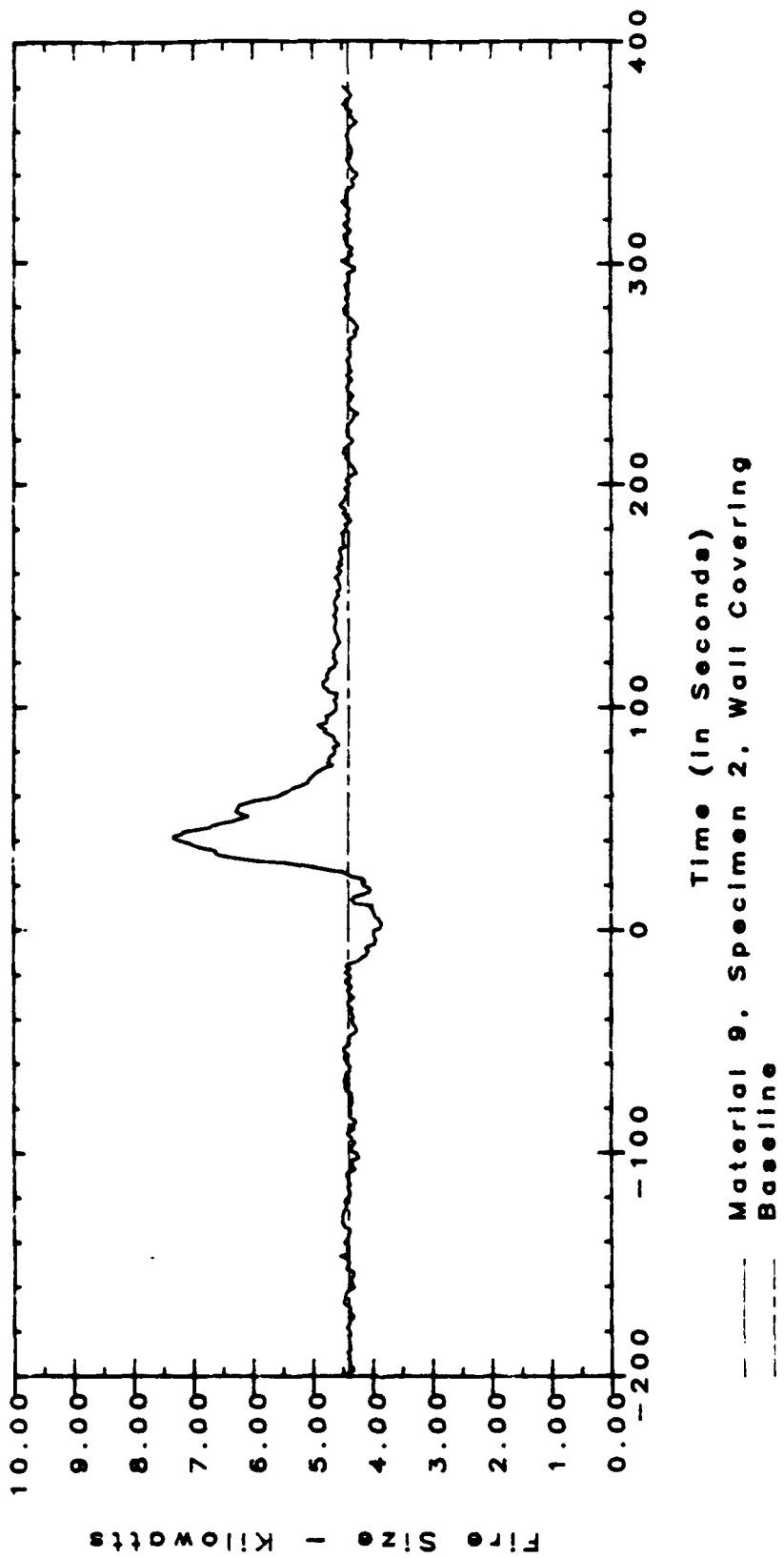
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TEST: M9S2SP2 Specimen Number 2  
DATE: 21 July 1987  
MATERIAL: Wallcovering

USCG -IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10-15	250-300	Spontaneous bubbles across specimen
18	up to 200	Intermittent flames and black char
20-45		Intermittent flames turning to steady flames and surface alligatoring across specimen, flames about 6" into stack
50		Pyrometer 3.86mv
55	up to 450	Surface bubbles across specimen
60	up to 350	Black char
65	0-200	Flames have ceased, no flames
70-80	200-250	Small intermittent flames above center line
90	up to 450	Bubbles across specimen
97-110	up to 300	Intermittent flames about 2" in height
115	0-100	Material has separated from specimen and flaking off backing
124	300	Intermittent flames have ceased
130	up to 450	Light smoke, bubbles
135	up to 350	Dark char, light char up to 400mm
150	300	Material has separated from specimen, still attached, light smoke
165		Pyrometer 3.88mv
220	up to 400	Dark char, very light smoke
225	up to 450	Light brown char
235	up to 500	Surface bubbles across specimen above and below center line
240		Pyrometer 3.89mv
300		No further progression, pyrometer 3.90mv
315	0-200	Material has separated from specimen backing but still attached
325	200-250	Material is raised off specimen backing
335	250-400	Complete black char
340	400-475	Light brown char
350	475-500	Bubbles above and below center line
355		Very light smoke
360		Pyrometer 3.90mv, test complete

IMO FLAME SPREAD TEST



TEST: M9S3SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

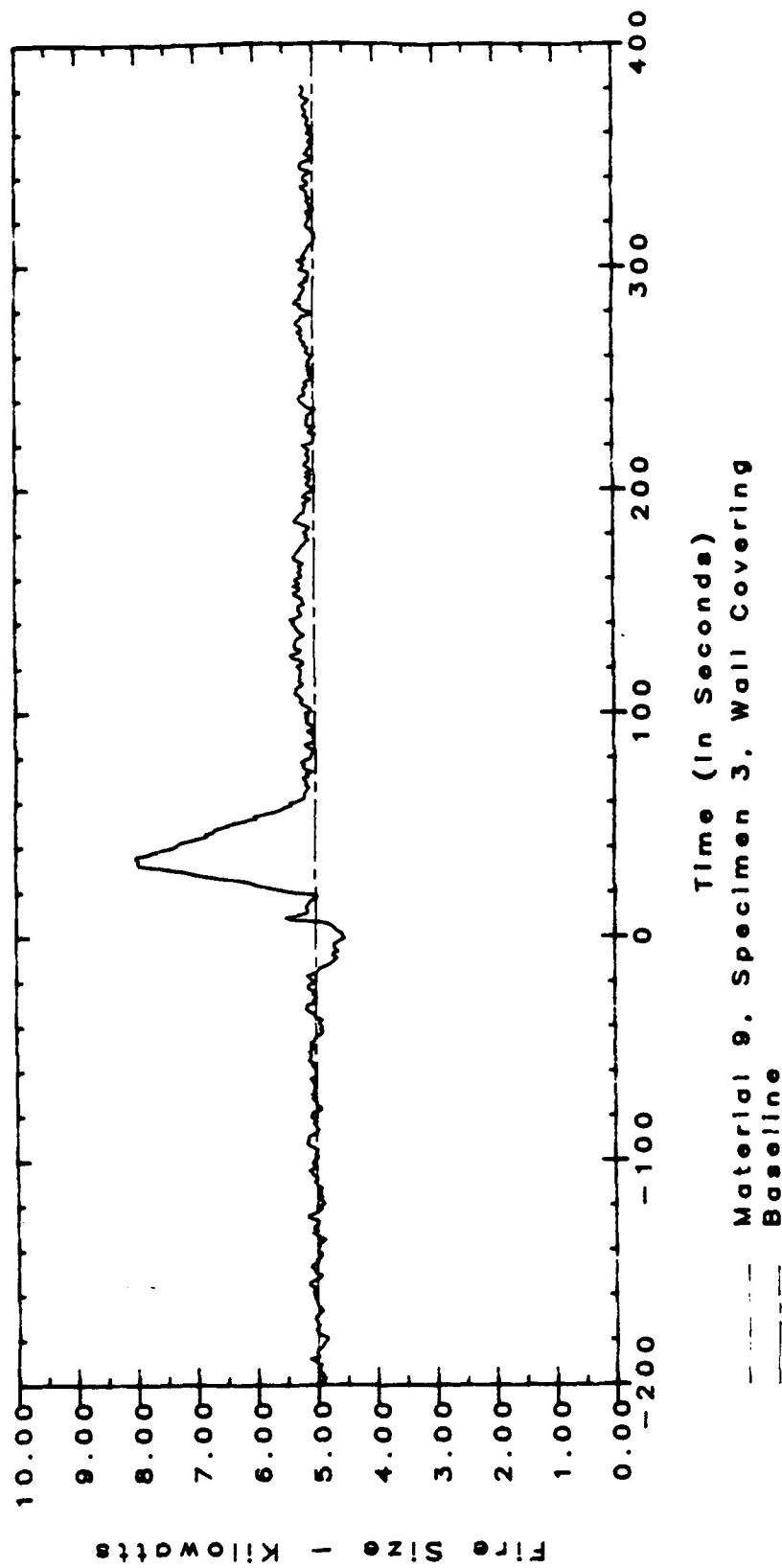
Time (sec)	Distance (mm)	Remarks
8	200	Spontaneous bubbles, smoke and intermittent flames
13	up to 300	Bubbles up to 250mm, 300mm, complete black char up to 200mm
20		Heavy smoke, surface starting to alligator, intermittent flames flickering on and off
30	0-200	Constant flames across specimen above and below center line, about 4-6" height into stack
40	300	Complete black char line
42	400	Progression of bubbles
45		Flames are flickering
52	0-200	Flames have ceased, flames are completely out on specimen
60		Moderate smoke
65		Pyrometer 3.87mv
85	350	Progression of char line above and below center line
90	450	Bubbles across specimen above and below center line
98	0-100	Material has separated from specimen, has not fallen off, raised off backing about 3"
120		No flames
175		Pyrometer 3.88mv
180		Light flame
185	400	Progression of char line across specimen above and below center line
188	450	Bubbles have not progressed
192-200	0-200	Material has separated from specimen backing, has not fallen off, just curled back along specimen holder
205		Subject material turning white with char
280		Pyrometer 3.89mv, very little smoke

TEST: M9S3SP2 Specimen Number 3 (cont'd)  
DATE: 27 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
300-317	0-200	Material has separated from specimen completely, no material left on, it is hanging onto specimen holder and curled away from backing, turning to white char
322	200-250	Complete white char line
325-332	250-400	Complete black char line across specimen above and below center line with surface alligatoring
337	450-475	Light brown char line
340	475-500	Bubbles across specimen above and below center line
350	0-200	Material is still attached to specimen and just curled back along specimen and holding
360		Pyrometer 3.89mv, test secured

IMO FLAME SPREAD TEST



B-2.195

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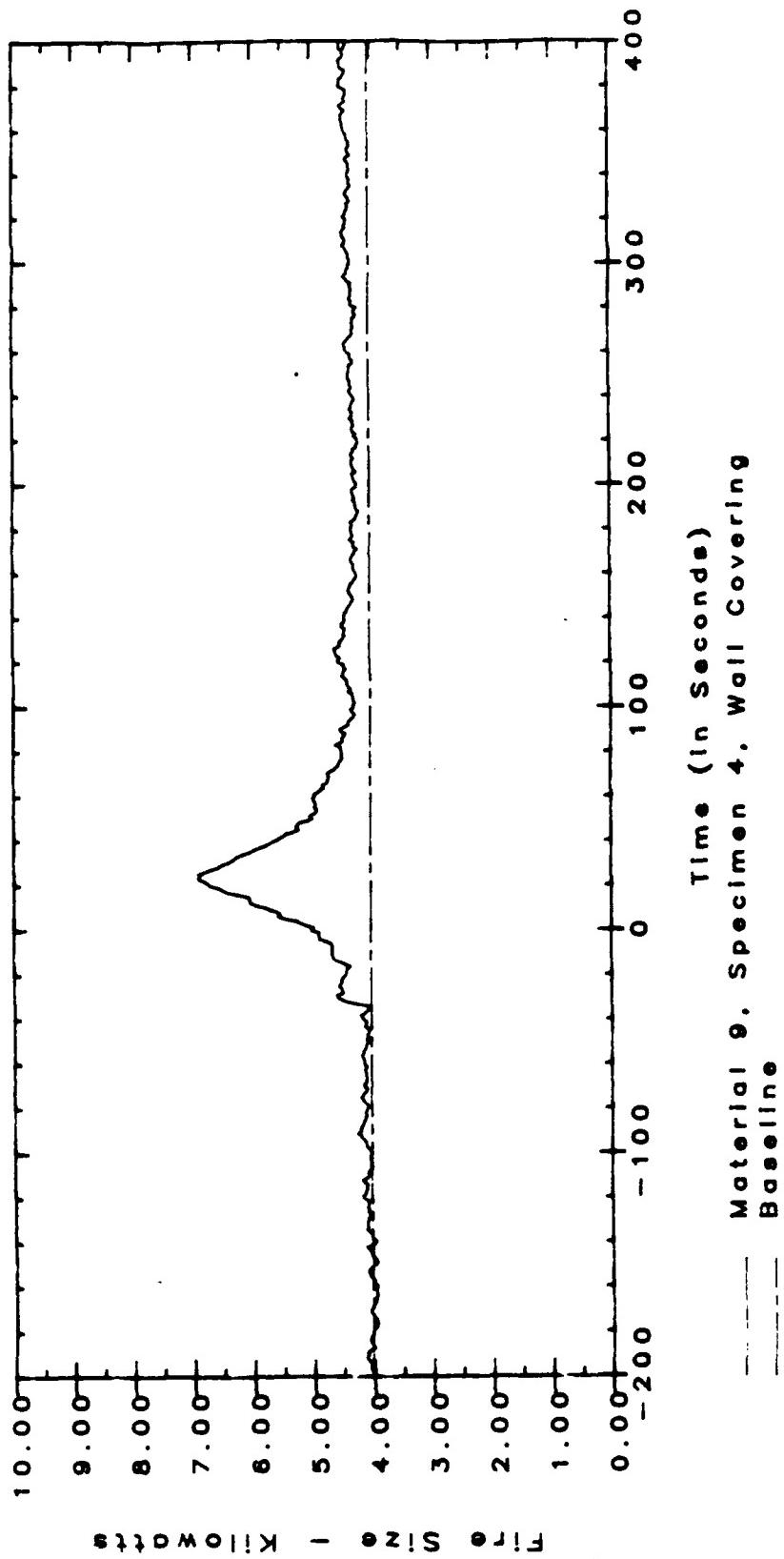
B-2.196

TEST: M9S4SP2 Specimen Number 4  
DATE: 29 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5	50-200	Spontaneous charring 50, 150, 200mm
15	350	Spontaneous bubbles
20	250	Charring
25	100	Intermittent flames, flickering
35	400	Progression of bubbles across specimen above and below center line
38	300	Progression of char line
43	200	Flames across the specimen about 4" (height) into stack
55	0-200	Intermittent flames have ceased
64	200-250	Intermittent decreasing about 2" (height) into stack, moderate smoke
73	450	Bubble across specimen above and below center line
75	400	Char across specimen
80		Flames still flickering on and off
90	300	Flames have ceased
96		Pyrometer 3.89mv, light smoke
130-145	0-200	Material has separated from specimen curling back along sample toward 750mm, still attached to specimen, light smoke
335-345	0-100	No material left on specimen except for top and bottom of sample along holder curled toward radiant panel
350	100-250	Material is curled back along specimen toward 750mm mark
360	150	No material left on specimen above center line
375	250-400	Dark brown char line with alligated surface
385	400-475	Light brown char line
398	500	Bubbles above and below center line
405		Pyrometer 3.91mv, test complete

IMO FLAME SPREAD TEST



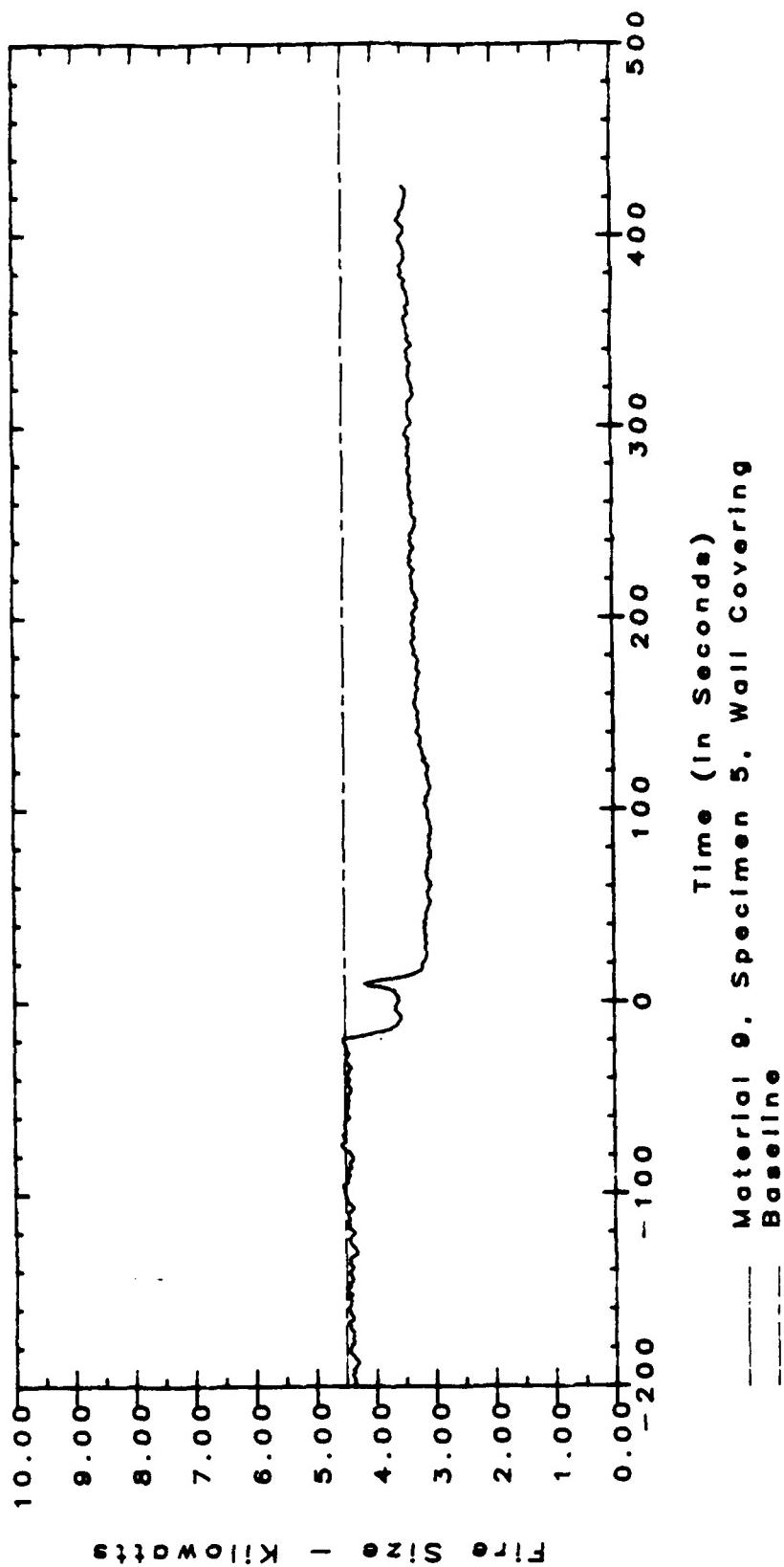
B-2.198

TEST: M9S5SP2 Specimen Number 5  
DATE: 30 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
12	up to 150	Spontaneous bubbles and intermittent flames
15		Intermittent flames have ceased
18	150	Complete black char
22	250	Bubbles and black char across specimen
26		Heavy smoke, horizontal pilot flame went out, secured fuel gas
45	0-200	Complete black char and surface alligatoring
55	400	Bubbles above and below center line
60		Pyrometer 3.76mv, heavy black smoke
120		Pyrometer 3.80mv
125-138	0-150	Material separating from backing and curling toward radiant panel, material turning to white char
145	150-350	Complete black char line with alligatorized surface
155	400-550	Bubbles across specimen above and below center line, light smoke
170-190	0-200	Material has separated from backing and curling toward radiant panel, can fall off anytime
365		Pyrometer 3.89mv, all activities ceased
375	0-200	No material left on specimen except for around edges of holder
385	200-300	Material has curled back along the length of holder, still attached
400	300-450	Complete black char line with surface alligatoring
410	400-475	Light brown char line
415	400-500	Bubbles above and below center line
425		Pyrometer 3.91mv, test complete

IMO FLAME SPREAD TEST

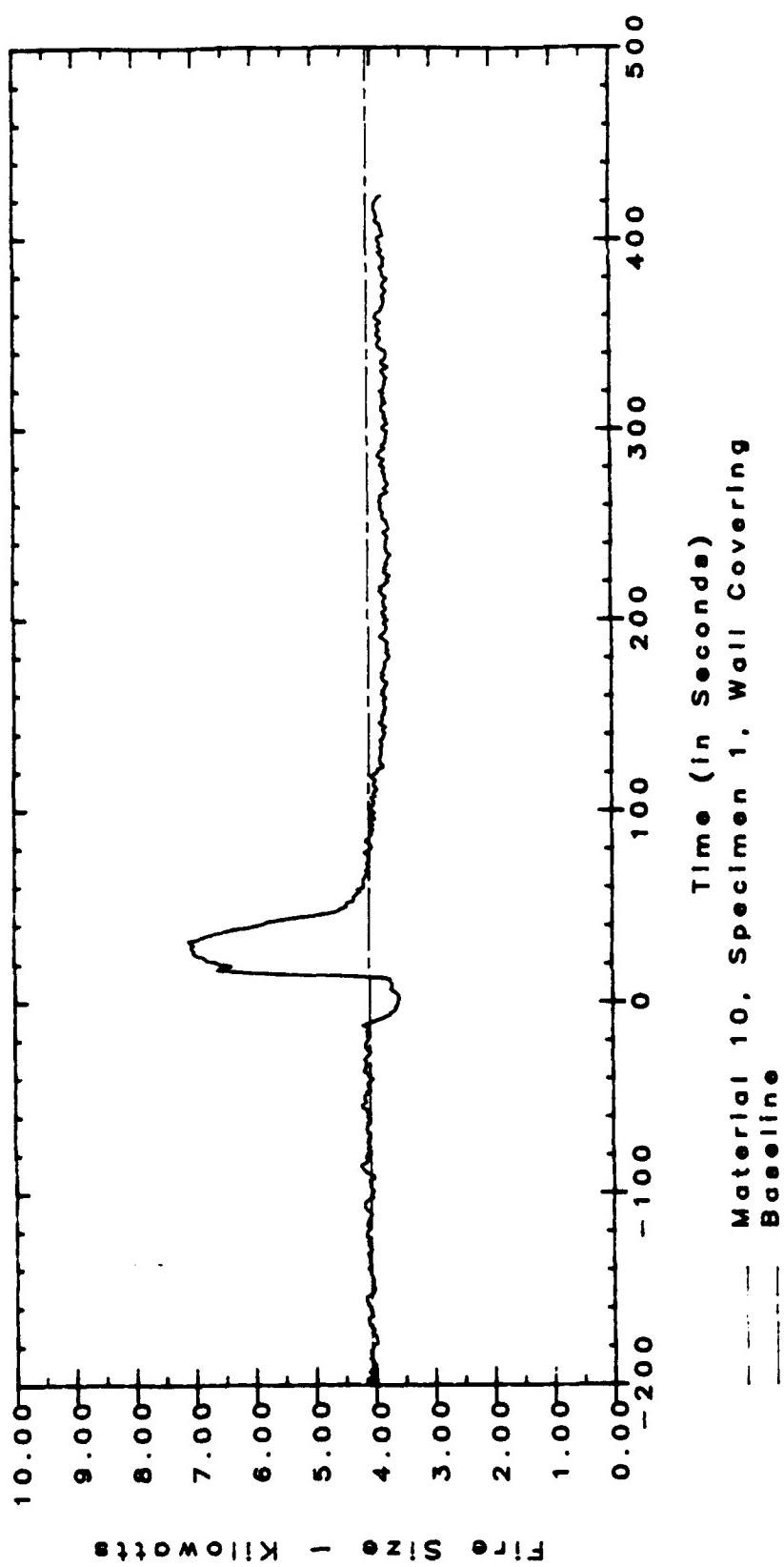


TEST: M10S1SP2 Specimen Number 1  
DATE: 17 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10	up to 200	Light smoke
15	up to 200	Spontaneous flames up to 200mm
24		Surface completely covered with black char, intermittent flames are not progressing
34		Pyrometer 3.80mv
40-45		Intermittent flames out
53	up to 350	Surface is alligated and char line up to 350mm, light smoke
67-75	350-600	Light surface bubbles 1/8" dia., light smoke
105		Pyrometer 3.83mv
115	0-200	0-200mm is alligated, completely black with char
120-138	200-400	Complete black char with alligator increase
135	0-600	0-100mm surface turning white char, surface bubbles 600mm
155		Material is intact with specimen backing, light smoke
170	up to 200	Complete white char
185	200-400	Black char, very light smoke
192	600	Surface bubbles, pyrometer 3.84mv
233	250	White char
238	250-450	Black char with alligated surface
248	600	Bubbles still at 600mm, very light smoke
255		Material is still intact to specimen backing
270	450	Black char line has ceased to progress past 450mm
313		Pyrometer 3.86mv
338		Smoke has ceased
364	0-250	Complete white char across the face of the surface and alligated
372	250-475	Black char and alligated up to 450mm
383	475-600	Surface bubbles 1/8" in size
390		No smoke
405		Test complete

IMO FLAME SPREAD TEST



TEST: M10S2SP2 Specimen Number 2

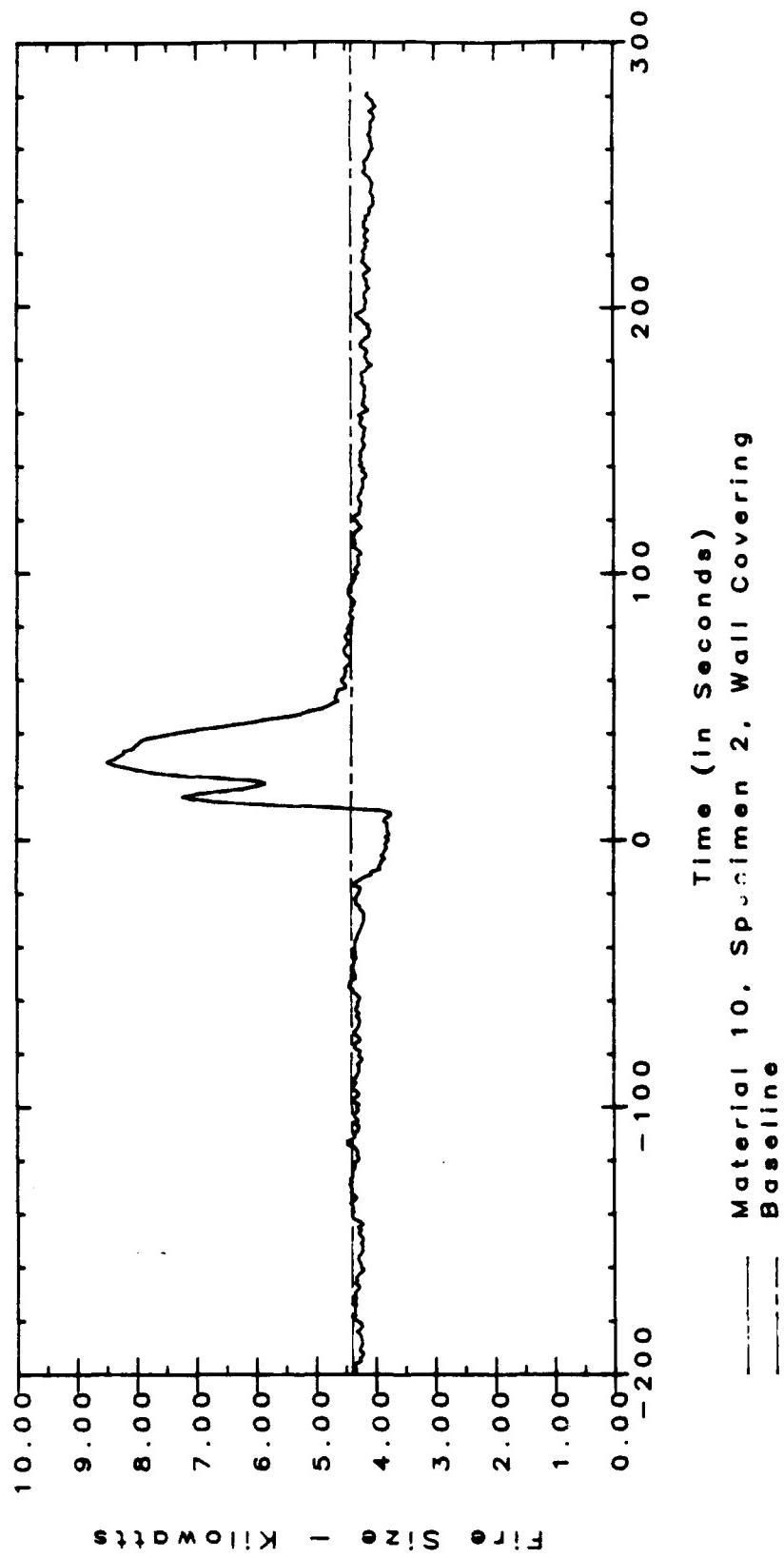
DATE: 21 July 1987

MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7-12	450-550	Spontaneous bubbles across surface
15	up to 200	Intermittent flaming
20		Intermittent flaming has ceased
25	up to 200	Intermittent flaming again
35	up to 250	Intermittent flaming 6" into stack
40		Pyrometer 3.83mv
45		Intermittent flaming has ceased, moderate smoke
55	up to 350	Dark black char line
60	up to 550	Surface bubbles above and below center line
70-80	350	Light smoke, specimen has alligated up to char line at 350
85		Pyrometer 3.84mv
120	up to 400	Char line, surface alligated, light smoke
127	up to 600	Bubbles above and below center line
132	0-150	Specimen has turned to white char
140		No flame spread, light smoke
145		Pyrometer 3.86mv
220		No further progression, pyrometer 3.89mv
235	0-250	Specimen has alligated and turned to white char
245	250-450	Specimen has alligated and turned to black char
250-260	450-600	Specimen has small bubbles across surface above and below center line
270		No flaming, smoke ceased, test complete

IMO FLAME SPREAD TEST



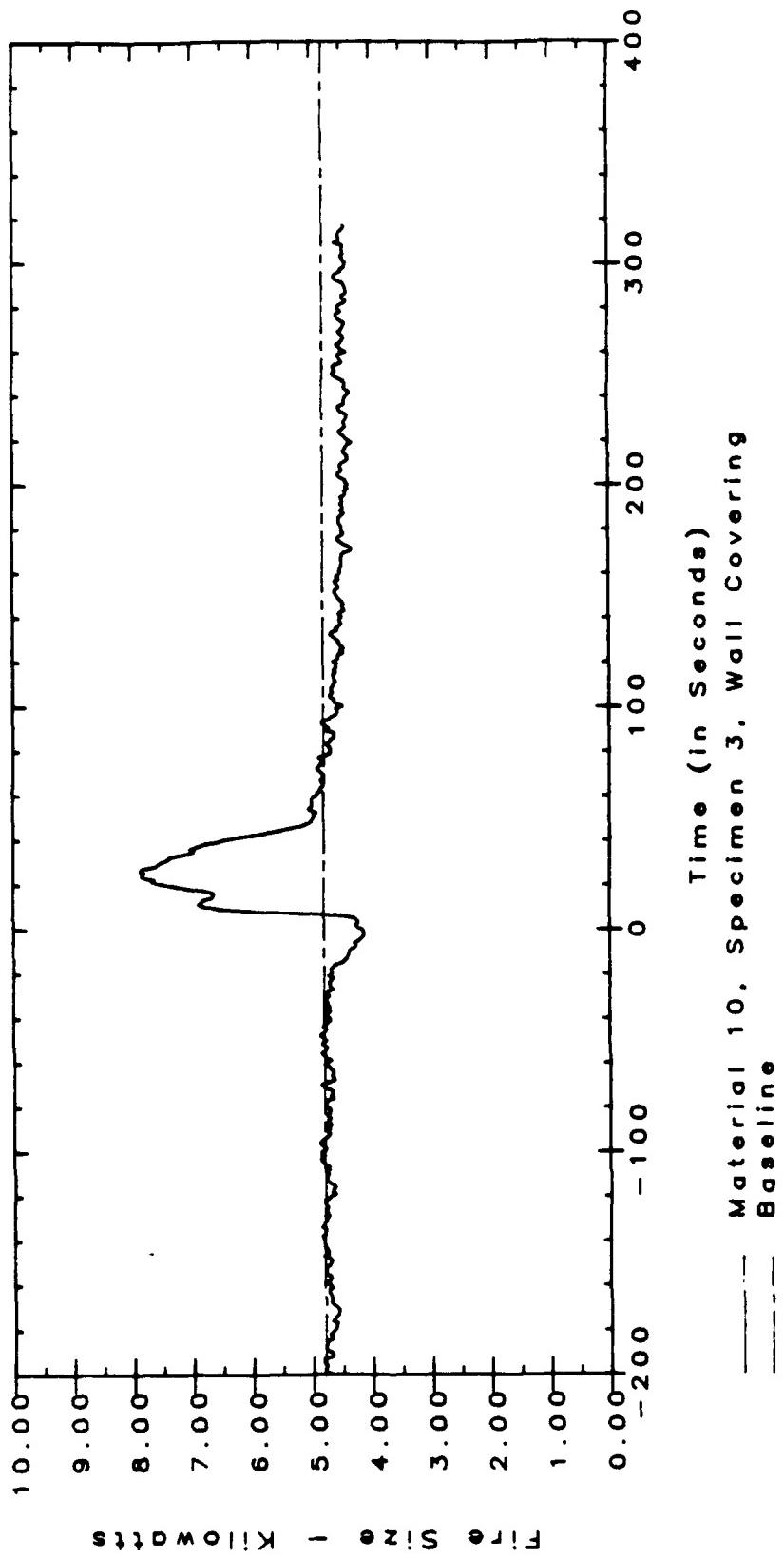
B-2.204

TEST: M10S3SP2 Specimen Number 3  
DATE: 27 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7-17	up to 400	Spontaneous bubbles, instant charring, flames are intermittent up to 250mm flickering on and off
22-31	300	Flames are steady now, about 4" height into stack across the specimen, above and below center line
35	450	Bubbles across specimen above and below center line
40		Intermittent flames, flames have ceased
45		Moderate smoke
53-60	0-450	Complete black char across specimen above and below center line with alligated surface, light smoke
65	350-550	Bubbles across specimen above and below center line
75		Pyrometer 3.86mv
160		Pyrometer 3.89mv, very light smoke
173	0-200	Specimen turning white char and alligatoring
180	200-450	Complete black char across specimen above and below center line and alligatoring
188	450-575	Bubbles across specimen above and below center line
260		Pyrometer 3.92mv, all activities ceased, no smoke
272	0-250	Material white char and alligatoring
280	250-450	Complete black char and alligatoring above and below center line
288	450-600	Bubbles on the surface small in dia., 1/8" above and below center line
300		Test secured

IMO FLAME SPREAD TEST



TEST: M10S4SP2 Specimen Number 4

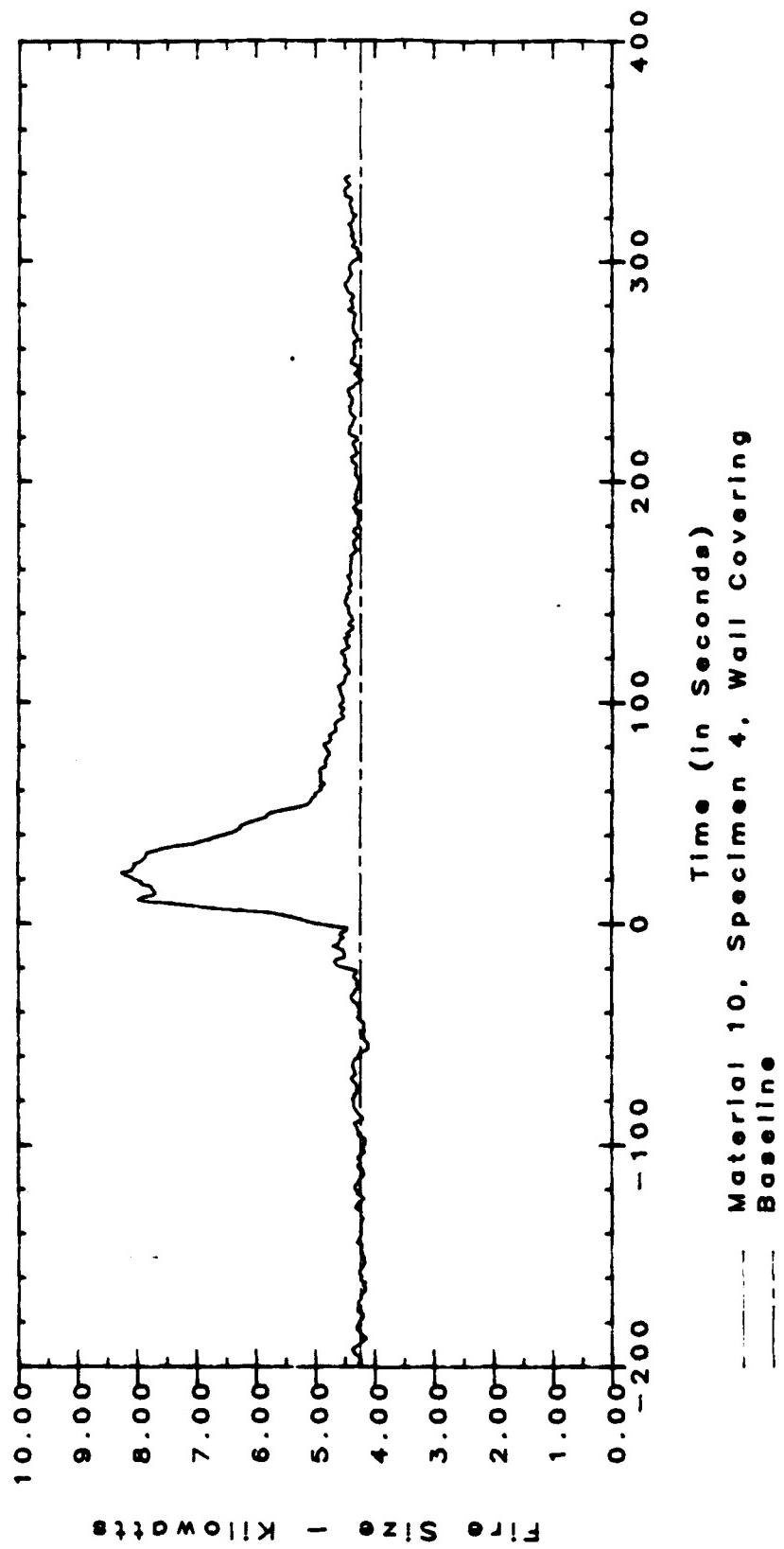
DATE: 29 July 1987

MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	up to 450	Spontaneous bubbles
12	up to 200	Spontaneous charring
20	0-200	Spontaneous intermittent flames across specimen, 4" (height) into stack
30	300	Complete char across specimen
35	500	Progression of bubbles across specimen
42	0-200	Flames have ceased
48	200-300	Intermittent flames are decreasing to about 3" into stack
55		All flames have ceased on specimen, no flame spread distance recorded on this test
65	350	Complete dark char line across specimen with surface alligatoring
75	600	Bubbles across specimen above and below center line, light smoke
80		Pyrometer 3.86mv
150	0-200	Complete dark char line across specimen
158	200-400	Lighter color char line
165	400-600	Bubbles across surface with 1/2" dia. bubble at 575mm
175	0-425	Alligated surface across specimen, light smoke
180		Pyrometer 3.89mv
265		Pyrometer 3.90mv, no further progression
275	0-250	Surface alligatoring and dark char line
290	250-425	Surface alligatoring and lighter char line
300	425-600	Bubbles across specimen with 1/2" dia. bubble at 575mm
310		Pyrometer 3.92mv, test complete

IMO FLAME SPREAD TEST

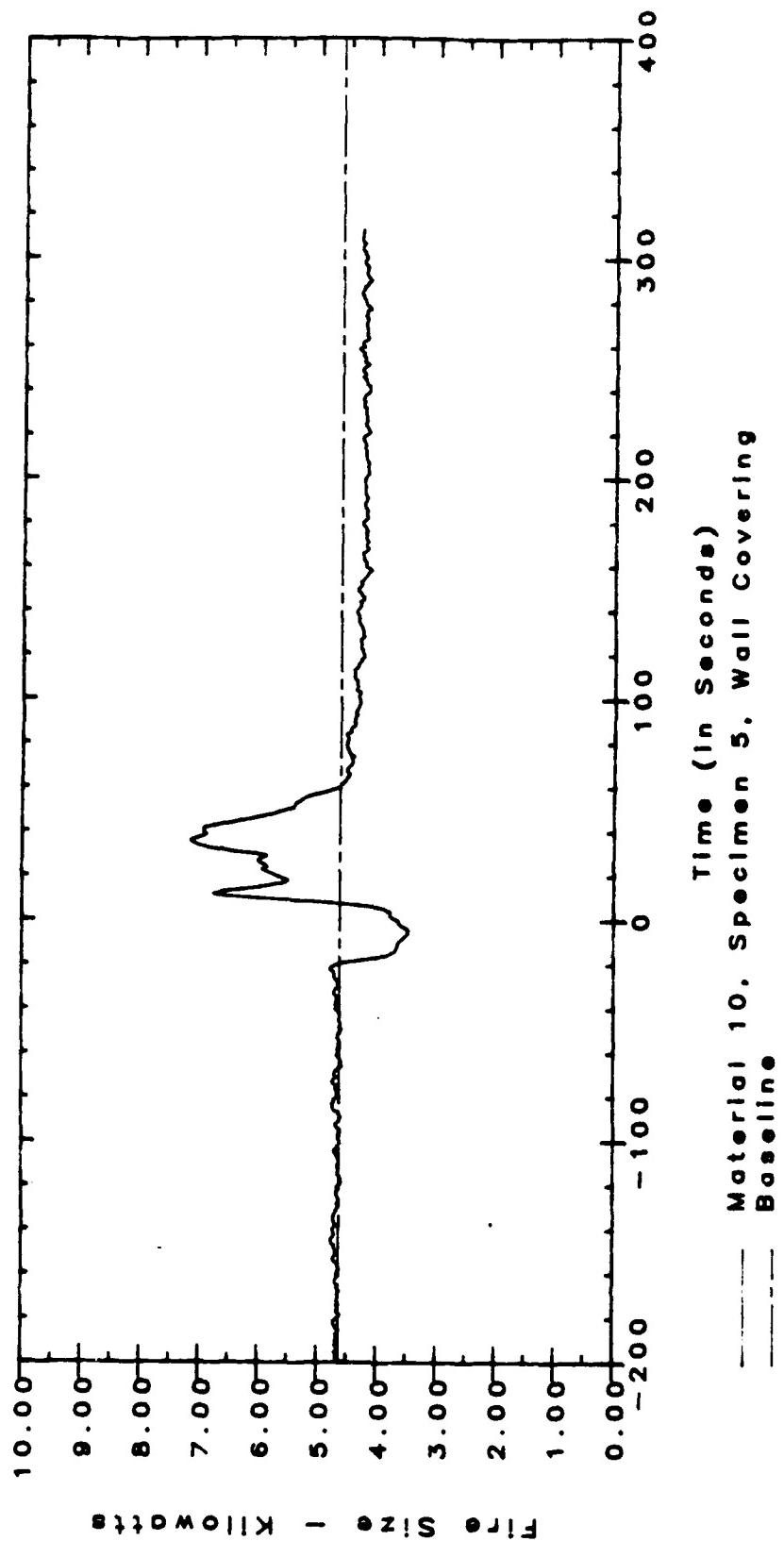


TEST: M10S5SP2 Specimen Number 5  
DATE: 30 July 1987  
MATERIAL: Wallcovering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5	up to 300	Spontaneous bubbles
12	up to 200	Spontaneous flames
16	300	Intermittent flames have ceased
24		Intermittent flames started again
30	500	Bubbles across specimen above and below center line
35	350	Complete black char with intermittent flames turning steady about 4-5" into stack
50		Intermittent flames now
60		Intermittent flames have ceased
68	350	Complete black char and alligated surface
74	500	Bubbles across specimen, light smoke
250		Pyrometer 3.88mv, no further activities
275	0-250	Specimen white with char and has an alligated surface
287	250-450	Black char and alligated surface
300	450-650	Bubbles across specimen
310		Pyrometer 3.90mv, test complete

IMO FLAME SPREAD TEST



B-2.210

**APPENDIX B - PART III**  
**IMO TEST DATA**

TEST: M15S1SP2 Specimen Number 1  
DATE: 13 October 1987  
MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
20	up to 200	Loud explosion surface delamination up to 200mm
27	0 - 200	Heavy flaming of exploded separated material
35	up to 300	Surface bubbles progresses to 300, flames 6" height
45 - 60		Summary: The explosion at the beginning was about 200mm in diameter. It separated from the specimen backing then started a heavy steady flaming across the face of the material
65	250	Flame front
70	250 - 350	Light brown char and bubbles across surface
75	200	Material had separated from specimen and falling
110 - 125		Unstable flame front with surface flames on specimen that had separated from backing, there is no flame spread on this specimen
132	450	Surface bubbles
145	0 - 200	Material has separated completely off the specimen backing
157	250	Light unstable surface flames, that are burning the separated material from backing
173		Pyrometer 3.66mv
190	300	Unstable flaming with light smoke
220	0 - 300	Total disintegration of material on specimen
230	300	Unstable flaming of material that has separated from test specimen
350	0 - 350	No material is left on specimen backing
370	350 - 450	Bubbles and dark brown char on surface
376	450 - 500	Light brown char, no flaming
385 - 397	350	Material has separated from backing and curling back toward 750mm position, white with char and glowing with small pieces falling off
400		No smoke
415		Pyrometer 3.65 mv

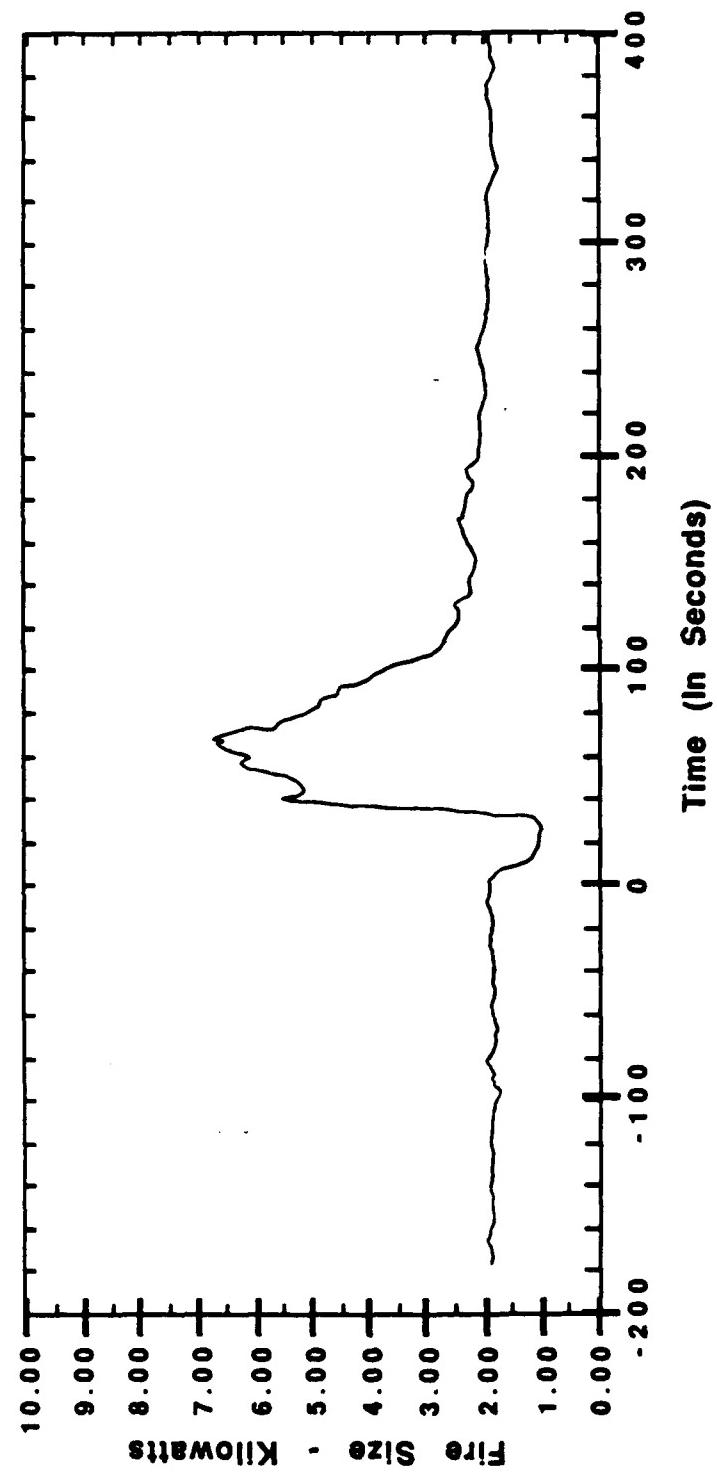
TEST: M15S1SP2 Specimen Number 1(cont'd)

DATE: 13 October 1987

MATERIAL: Laminate

Time (sec)	Distance (mm)	Remarks
427		All flaming has ceased, this specimen will remain in position another 3 min.
570	0 - 375	Total disintegration of material from specimen backing
580	375 - 475	Dark brown char line
585	475 - 525	Light brown char line
593	525	Final position of surface bubbles
605 - 625	375	Material has separated from backing and curling back toward 750mm position, which with char, and glowing
636		Pyrometer 3.65mv
495	250	At center line, intermittent flames, material flaking off
520	0 - 200	Material has separated from original backing
527	200 - 250	Slight separation, intermittent flames
538	250 - 450	Complete black char, surface bubbles up to 550mm
555		Pyrometer 3.97mv
590		All activities have ceased
618	0 - 250	Final appearance, material has completely separated from backing of specimen
629	250 - 300	Material has separated from backing but still attached to the rest of the material on specimen
644	250 - 450	Complete black char
655	450 - 500	Surface bubbles above and below center line
665		Pyrometer 3.95mv Test complete

IMO FLAME SPREAD TEST



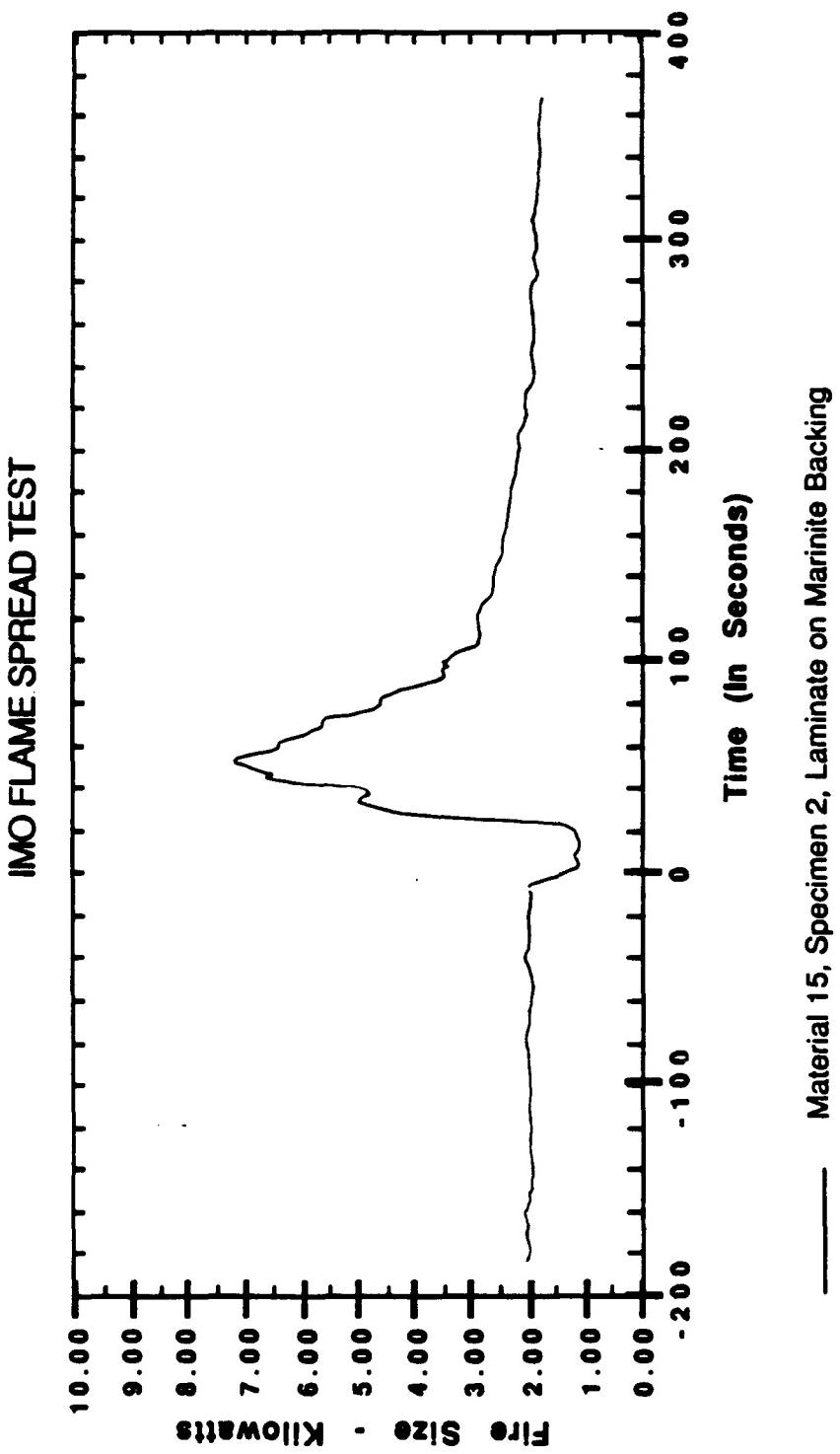
Material 15, Specimen 1, Laminate on Marinite Backing

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TEST: M15S2SP2 Specimen Number 2  
 DATE: 15 October 1987  
 Material: Laminate

USCG IMO - SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
19-25	0 - 100, 150, 200	Spontaneous explosions
35	150	Unstable flaming of exploded material moderate smoke, brown charring
47	200	Unstable flaming front
53	250	Unstable flame front
60	350	Bubbles and char progression
91	300	Stable flame front about 3" into stack
103 - 115	0-200	Sparks and pieces of material falling off. The specimen leaving an exposed backing. Pieces are still burning.
125	360	Unstable flame front
132		Spread distance
140	450	Bubbles across the specimen above and below center line
145	425	Brown char line
152	300	Unstable flaming has reignited
157 - 170	0-250	Material has separated from backing and is falling off, material around specimen holder is turning white char
180	300	Unstable flame
195	3.70mv	Pyrometer reading
222	300	Unstable flame about 1/2" off surface flickering on and off
243		Unstable flame is out extinguished at this time 310mm
255 - 267		0-310 material has separated and is falling from sample leaving an exposed backing, material around specimen holder is white char, sparking and falling off
277	3.68mv	Pyrometer reading, light smoke
538	3.65mv	Final pyrometer reading
548	0-325	No material left on specimen except around edges of specimen holder, white
with		char
555	325-450	Black char line
562	450-525	Light brown char line and final position of bubbles



TEST: M15S3SP2 Specimen Number 3  
 DATE: 16 October 1987  
 Material: Laminate

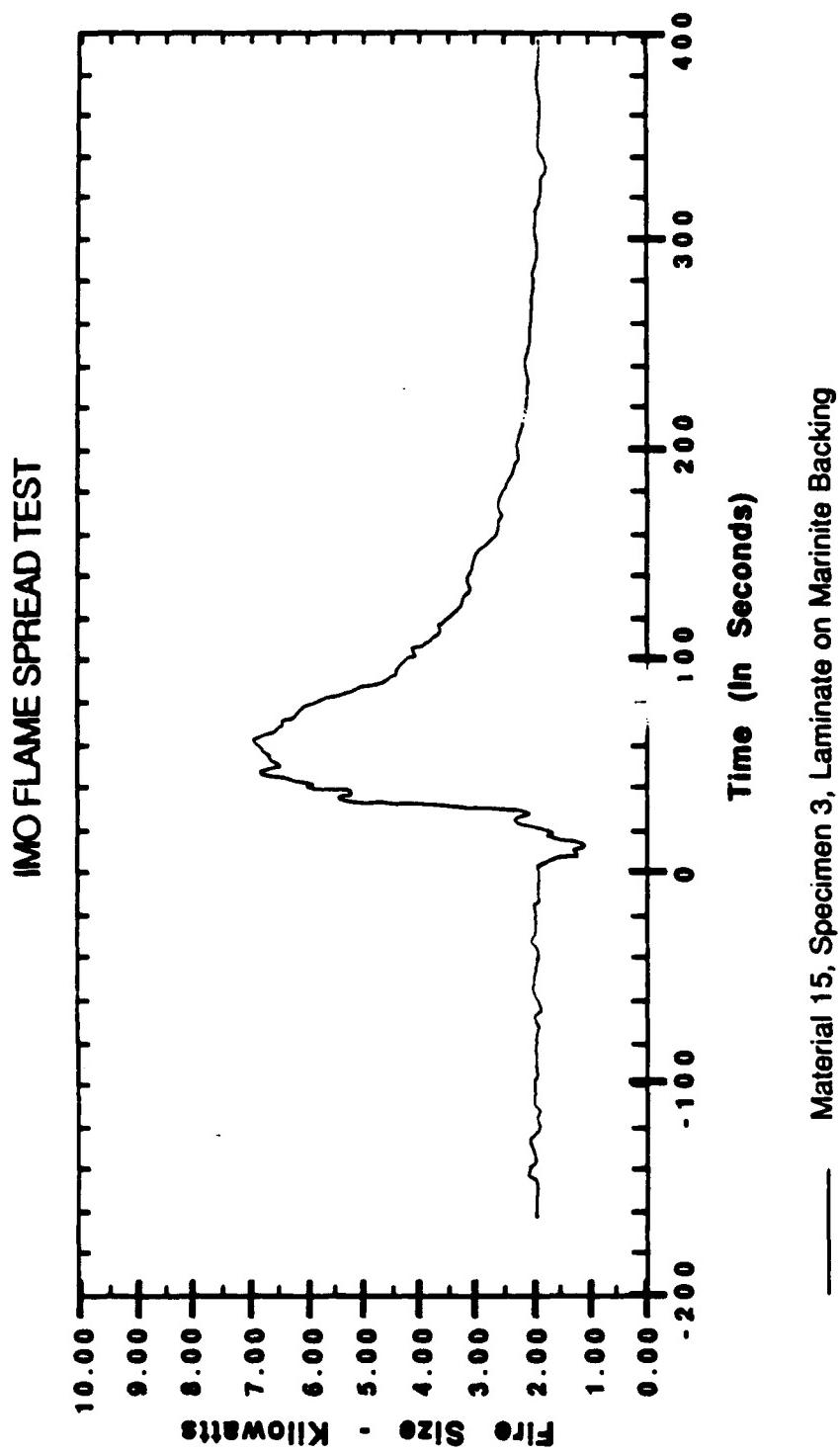
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
5 - 15		Spontaneous explosions, charring and flaming at the impinging pilot flame steadily progressing
16	50	Flame front
20		Explosions up to 100, 150mm
25		Black char up to 150mm, explosions up to 200mm
28		Black char up to 200mm, flame front 100mm
38	150	Flame front about 6" height into stack
50		Flame front 200mm across the specimen
60	350	Bubbles and black char
70	250	Flame front
78		Flames decreasing in height, steady progression across specimen
100	0-100	Material has separated from specimen backing, flames has decreased in size 2" into stack
115	300	Flame front stable
122	425	Bubbles across specimen above and below center line
125	350	Black char line
128	410	Light black char line
135 - 147	0-300	Flames are decreasing with material separating and starting to fall off with sparks
153	0-150	No flames
160	150-300	Light surface flames, steady at 300mm
175	0-300	Material has separated with red char and falling sparks
205		Flame front decreasing in size and becoming unstable 2"
235		Material at flame front is separating and curling back
250	250	Unstable flaming at flame front 1" height
275	275	Flame front out extinguished
297	3.71mv	Pyrometer reading
505	3.66mv	Pyrometer reading
510 - 517	0-350	No material left on specimen except for around edges of specimen holder, white with char

TEST: M15S3SP2 Specimen Number 3 (cont'd)  
DATE: 16 October 1987  
Material: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time <u>(sec)</u>	Distance (mm)	Remarks
522	350-450	Black char line
527	450-520	Light brown char line
532	350-450	Bubbles across specimen above and below center line
543	3.65mv	Pyrometer reading



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TEST: M15S4SP2 Specimen Number 4  
 DATE: 23 October 1987  
 MATERIAL: Laminate

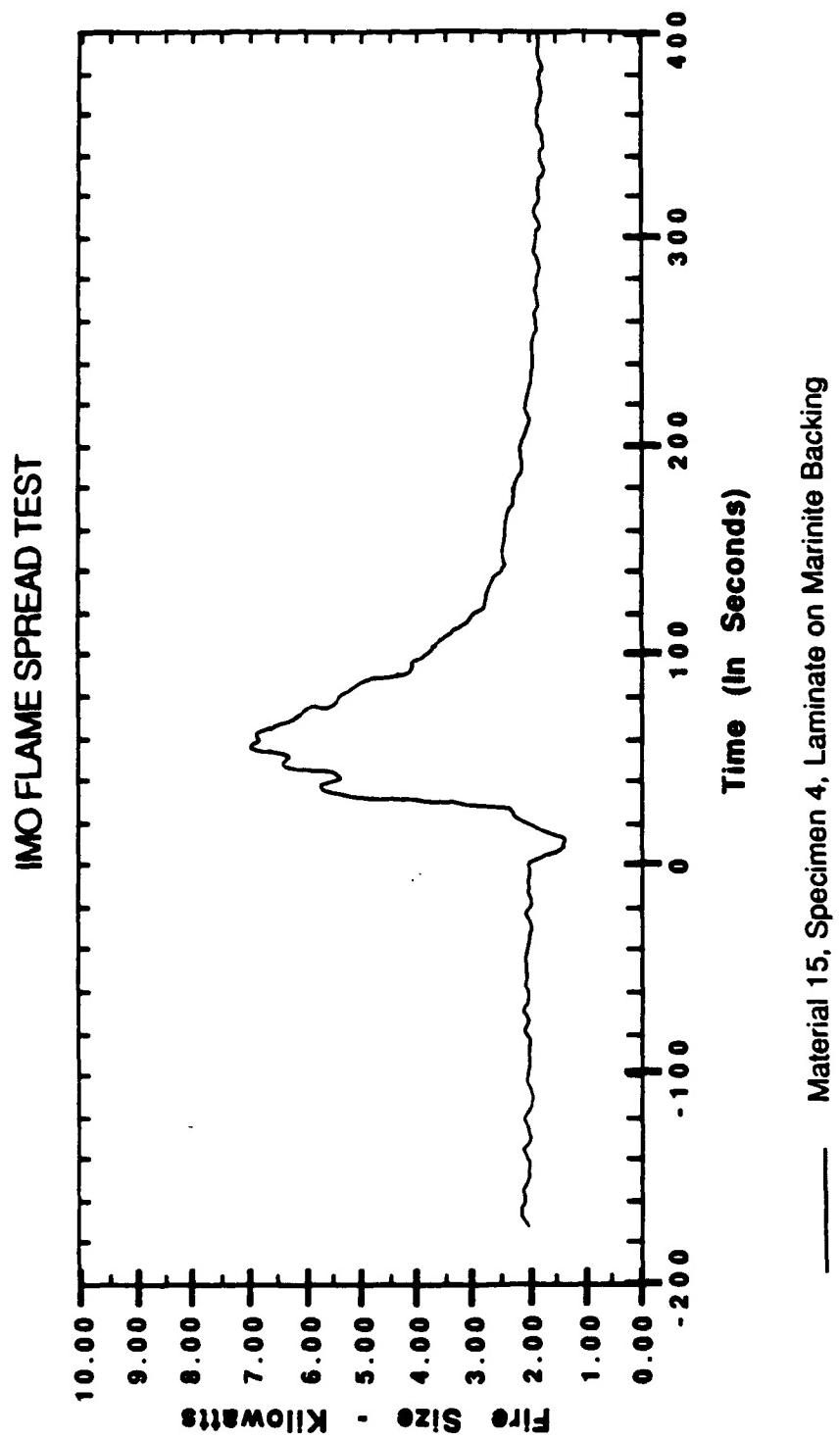
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7		Explosions and charring at the impinging flame
19	0-100 - 150	Explosions
	100 - 150	
23	0 - 150	Black char
26	200	Progression of bubbles
31	100	Flame front started
38	150	Steady flame front across specimen, height of flames 4" - 6" into stack, black char and explosions
50	200	Steady flame front
62	350	Bubbles and black char
66	250	Stable flame front
80	3.61mv	Pyrometer reading
100	300	Flame front decreasing in size but still stable about 3" height into stack
110 - 120	0 - 100	No material left on specimen except for around edges of specimen holder. This material is red char and sparks
125 - 132	100 - 350	Unstable flaming across specimen with flaming at 350mm about 1" off specimen and unstable
146		Flame front is out, extinguished with a flame spread distance of 350mm
157	200	Light surface flames, coming from material that has separated from specimen and falling off at this time
176	3.67mv	Pyrometer reading
206		All flames have extinguished on the specimen at this time
222 - 237	0 - 250	No material left on specimen surface turning red char and flaking off and turning white around holder
246	250 - 400	Complete black char line
252	400 - 460	Brown char line
255	460	Progression of bubbles
506	3.64mv	Pyrometer reading
510 - 525	0 - 300	No material left on surface except for around the edges of specimen holder with this material turning white with char
530	300 - 450	Black char line

TEST: M15S4SP2 Specimen Number 4 (cont'd)  
DATE: 23 October 1987  
MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
535	450 - 520	Brown char line
545	510	Progression of bubbles
550	3.64mv	Pyrometer reading



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TEST: M15S5SP2 Specimen Number 5  
 DATE: 24 October 1987  
 MATERIAL: Laminate

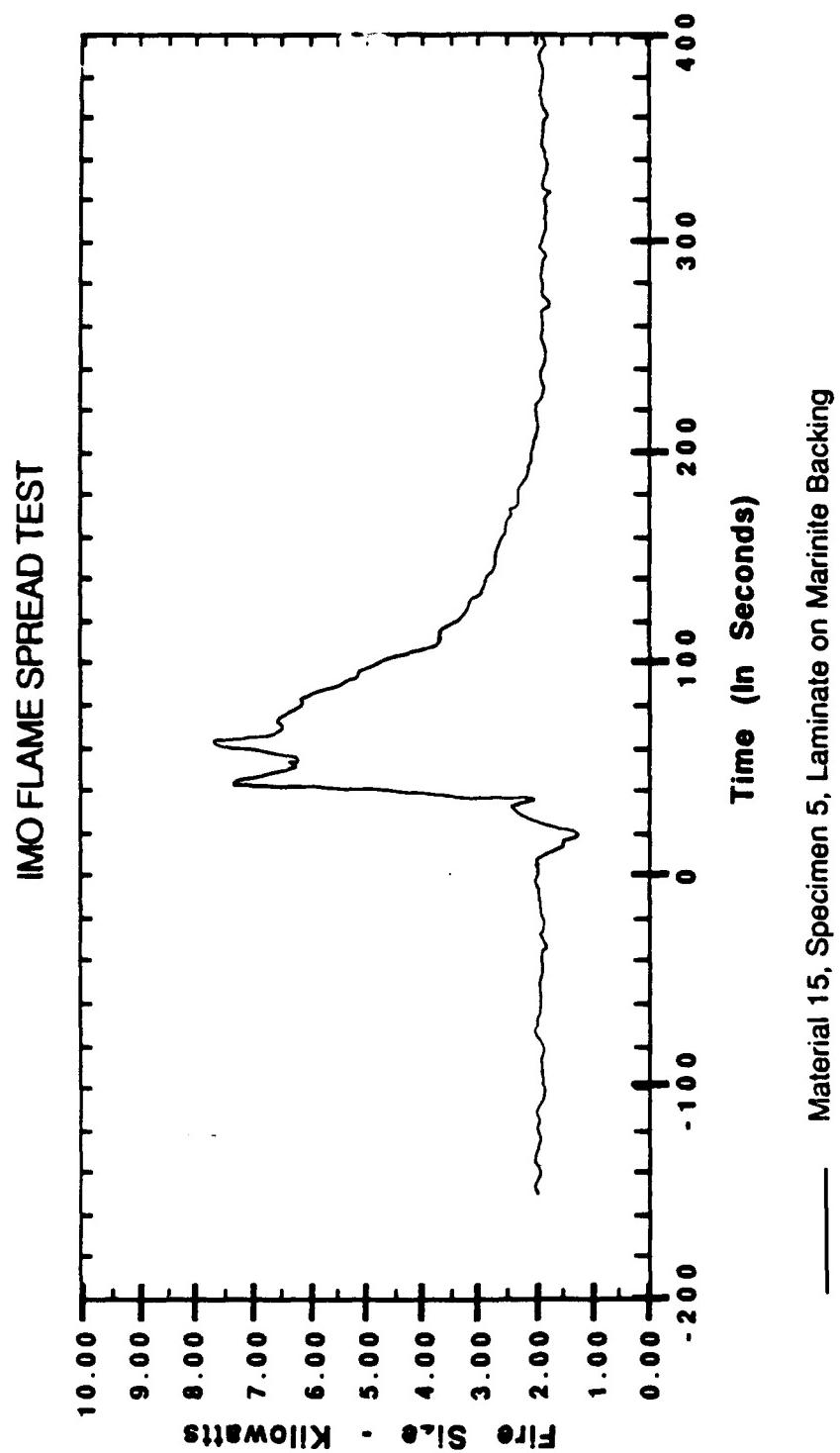
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8		Explosion, char and flaming at impinging flame
16	50	Flame and char
23	150 - 200	Bubbles
27	150	Black char
30	100	Flame front
33	200	Flame front
42	300	Progression of bubbles and black char
50	250	Flame front steady with 6" height in stack
58	300	Steady flame front
83	3.62mv	Pyrometer reading
88	375	Progression of bubbles and black char
92 - 103	0 - 200	Steady flaming is decreasing in size to about 4" into stack with material separating with sparks and red char, flaking off specimen
135	300	Flame front decreasing in size to 2" height off surface, becoming unstable flame
160	300	Flame front is unstable with light surface flames
195	300	Flame front is out, extinguished. This is the flame spread distance, with light flaming above the center line
210	3.66mv	Pyrometer reading
218	0 - 300	No material left on specimen except for around edges of holder turning white char
230	300 - 400	Black char
235	400 - 450	Brown char
238	450	Progression of bubbles
240		Flames are out on this test specimen NOW
245	3.64mv	Pyrometer reading
485	3.62mv	Pyrometer reading
490	0 - 300	No material left on specimen except for around the edges of holder, white with char
500	300 - 425	Black char
506	425 - 500	Brown char
510	500	Progress of bubbles

TEST: M15S5SP2 Specimen Number 5 (cont'd)  
DATE: 24 October 1987  
MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
515 - 525	300	Flame spread distance, but is not present on test specimen because black char has overtaken the material



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TEST: M16S1SP2 Specimen Number 1

DATE: 13 October 1987

MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
17	100 - 150	Large spontaneous explosion up to 100-150mm
25	200	Explosion up to 200mm, heavy flaming
28		Flaming is out, heavy smoke
32	150	Unstable flame front with material disintegrating 150mm
40	200	Flaming across the face of the surface up to 200mm about 6" in height into stack
50	300	Flames are at 300mm with material separating from specimen backing
60	350	Surface bubbles across the face of specimen
70	0 - 150	Material is disintegrating and separating from specimen backing.
105	0 - 150	Starting to flake off and red with char
120	150 - 350	No flaming but material is separating from backing and flaking off, red char
		Unstable flame front with surface cracks
135		Material separating from backing, flame height 3"
140	350 - 425	Light brown char line
147	425 - 450	Surface bubbles across specimen
150		Pyrometer 3.71mv
165	350	Flames are decreasing at 350mm 1/2" off surface
192	0 - 100	Material has disintegrated off surface
204	100 - 300	Material has separated and is flaking off the surface leaving an exposed backing
216	300	Unstable flaming on separated material and turning red char, light smoke
229	400	Dark brown char line
232	450	Light brown char line
237	475	Light surface bubbles across surface
250		Light smoke and very light unstable flaming on separated material
412		All flaming has ceased, very light smoke

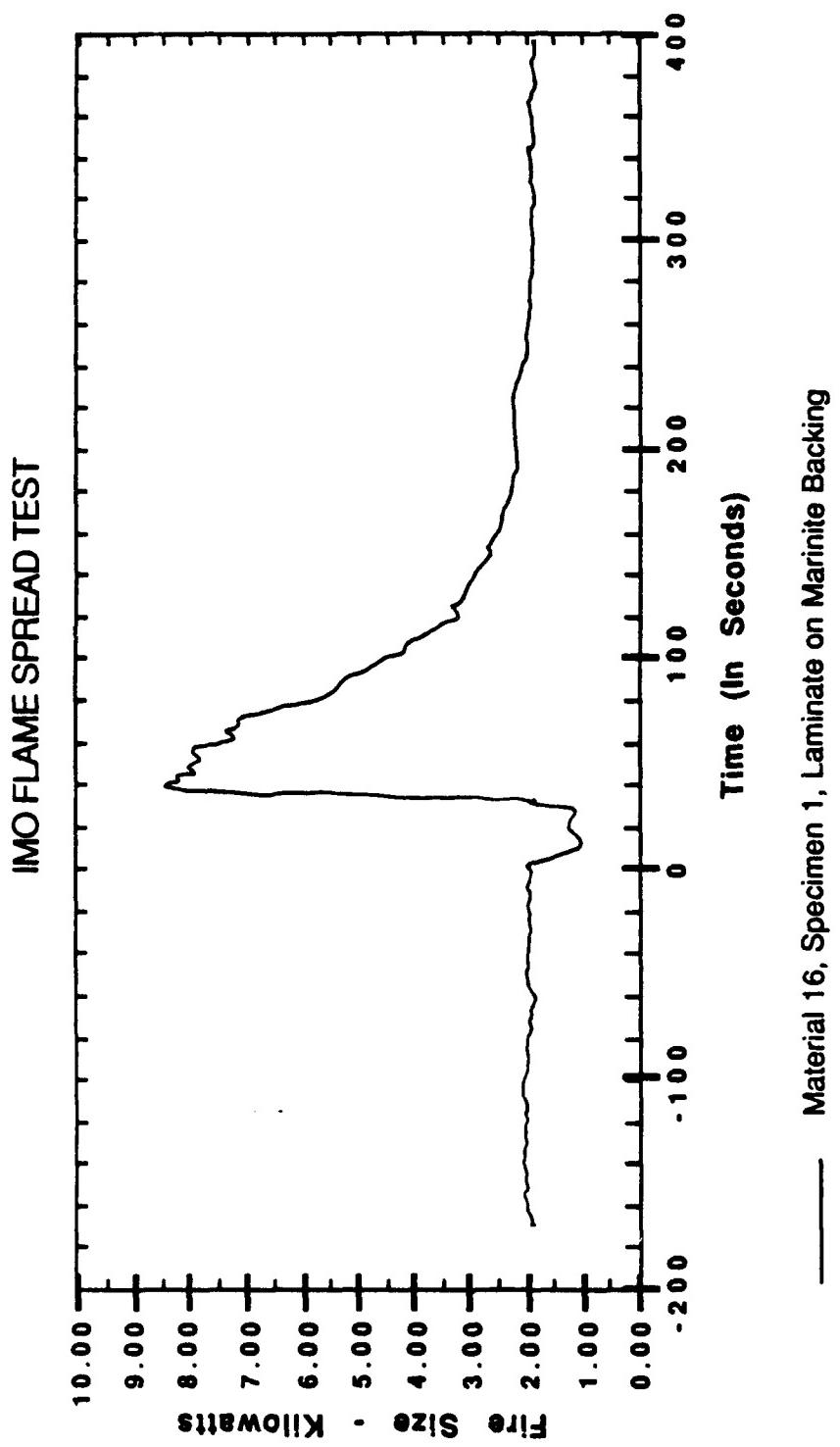
TEST: M16S1SP2 Specimen Number 1(cont'd)

DATE: 13 October 1987

MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
425	0 - 300	Material has disintegrated from specimen
437	300 - 350	Material has separated from backing and leaning toward radiant panel, red char
450	300 - 450	Dark brown char line
455	450 - 500	Light brown char line
460	500 - 525	Bubbles across specimen above and below center line
475		Pyrometer 3.66mv
610	0 - 300	No material is left on specimen and exposed backing
617	300 - 350	Material has separated from backing and is leaning toward radiant panel turning white char
630	300 - 450	Dark brown char line
635	450 - 525	Light brown char line
650	300 - 525	Bubbles across specimen
654		Pyrometer 3.65mv

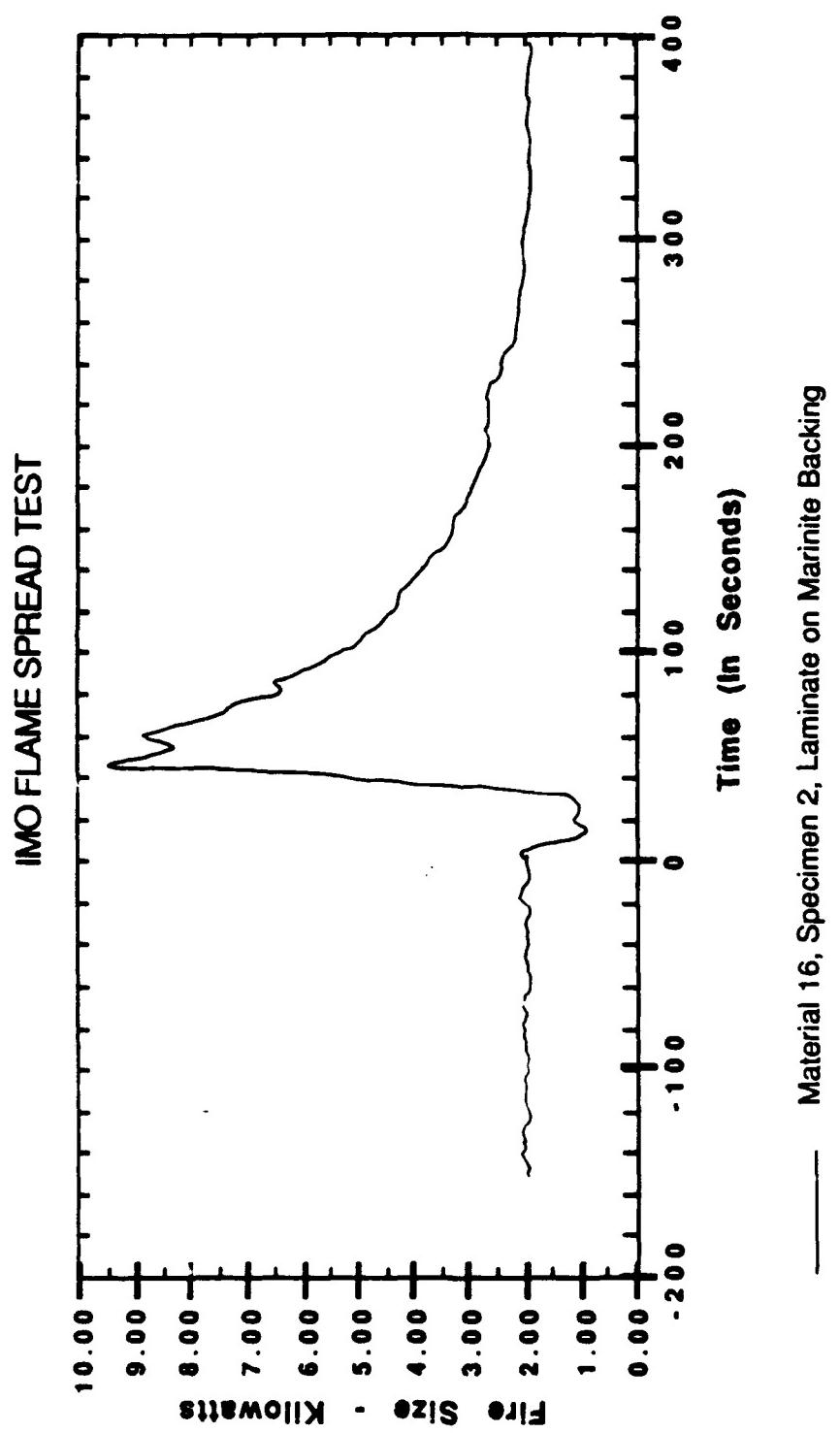


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TEST: M16S2SP2 Specimen Number 2  
 DATE: 15 October 1987  
 Material: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
18	0-50	Large bubble exploded
23	0-150	Surface explosions, heavy smoke and char
33	50	Flaming of exploded material
36	100	Flaming progress
41	150	Stable flame front
43	200	Stable flame front
45 - 65	250	Stable flame front about 6" height into stack burning material that had exploded and is starting to separate from specimen backing
71	300	Stable flame front
75	350	Bubbles and brown char front
85 - 95		Flaming still going into stack decreasing to 4" height, material is separating with sparks to red char falling off specimen leaving an exposed backing
98	3.64mv	Pyrometer reading
132	350	Stable flame front
145 - 160	0-300	Unstable flames with material separating turning to red char and sparks falling off specimen
220 - 235	350	Unstable flaming with height of flames 1" off specimen surface along center line
273	350	Final position of unstable flaming. All flames have extinguished at this position.
280 - 292	0-250	Unstable flaming on material that is falling off specimen, red with char, this material is only around the edges of specimen holder
297	3.70mv	Pyrometer reading
310	425	Dark brown char line
315	425-475	Light brown char line
320	500	Farthest position of bubbles
523 - 530	0-350	No material is left on specimen except for around edges of specimen holder
535	350-450	Dark black char line
540	450-525	Light brown char line and bubbles
546	3.64mv	Final pyrometer reading



TEST: M16S3SP2 Specimen Number 3  
DATE: 16 October 1987

Material: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

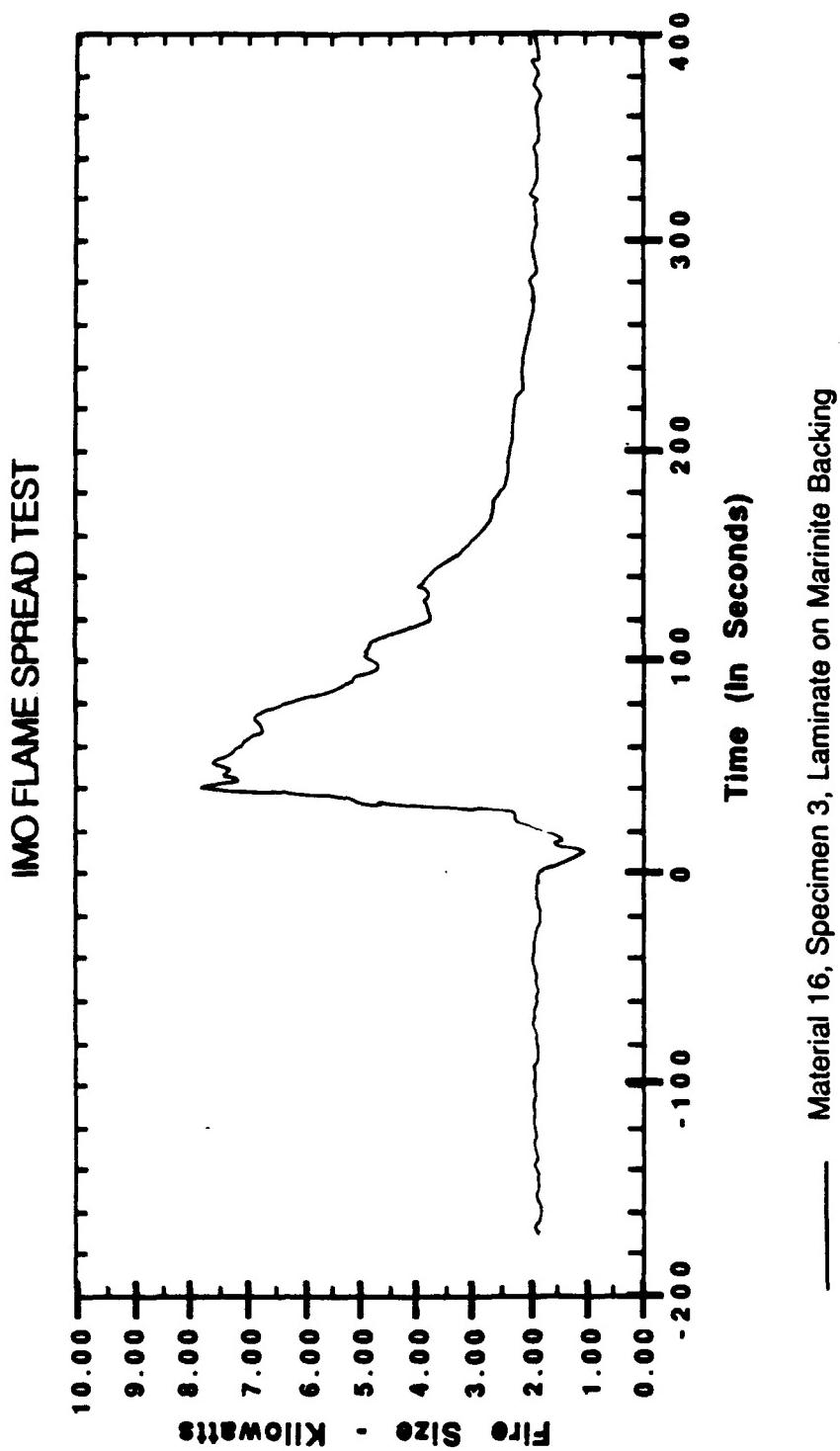
Time (sec)	Distance (mm)	Remarks
8		Spontaneous charring and flaming at impinging flame
12	50	Flaming
20		Spontaneous bubbling up to 100mm, 150mm, black char 150mm
26	50-100	Flaming
30	150	Flame front
35	250	Bubble and char line
47	200	Flame front about 6" height into stack
50	250	Flame front
55	300	Bubbles and char line
57	350	Progression of bubbles
62	250	Stable flame front 6" in height
80 - 95	300	Flame front across center line 6" height starting to decrease
97	350	Black char
100	400	Bubbles across surface
113	0-150	Material separating from backing, turning red char
137		Flames have decreased to 2" height above specimen holder
163 - 175	0-200	Material has fallen off specimen except around edges of holder red with char and light surface flames
198	310	Unstable flame front about 1" height
215	3.70mv	Pyrometer reading
230	320	Unstable flaming
244	300	Flame spread distance
258		Flaming decreasing to 1/2" in height, unstable
288 - 298	300	Flames very unstable flashing on and off with material separating from specimen backing
318	3.67mv	Pyrometer reading
328	320	Unstable flashing flames decreasing
345 - 355	0-300	No material left on specimen except around edges of specimen holder, white with char
360 - 373	300-325	Material is raised off specimen backing with flashing unstable, flames 1/2" off surface, red with char and light sparks and smoke

TEST: M16S3SP2 Specimen Number 3 (cont'd)  
DATE: 16 October 1987

Material: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
396	330	Flaming is out, extinguished
406	3.65mv	Pyrometer reading
600	3.64mv	Pyrometer reading
608 - 617	0-330	No material left on specimen except around edges of holder white with char
623	330	Material is red with char and raised off backing
630	330-450	Black char line
635	450-520	Light color char line
642	450	Bubbles across surface
648	3.63mv	Pyrometer reading

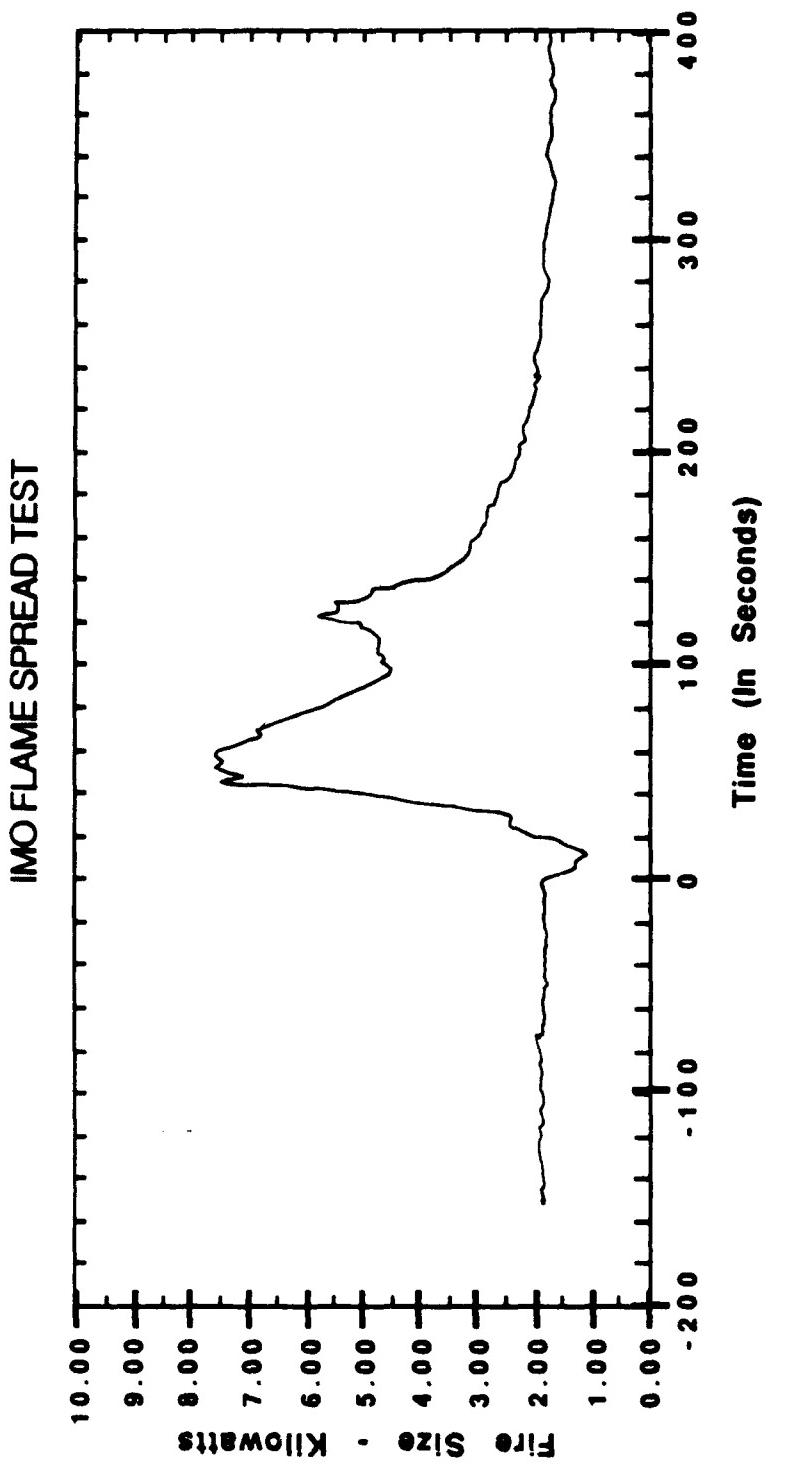


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TEST: M16S4SP2 Specimen Number 4  
DATE: 23 October 1987  
MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time sec	Distance (mm)	Remarks
8		Explosion and charring at impinging flame
12	50	Bubbles and char
20	50	Flaming started, bubbles up to 100 and 150mm
25	150	Black char
29	100	Unstable flaming flashing on and off
35	150	Stable flame across surface, 6" height into stack
45	300	Bubbles and black char
53	200	Stable flame front
63	300	Stable flame front
100	250	Still have stable flaming but decreasing in height to about 3"
155	350	Steady flame front about 3" in height
163	3.75	Pyrometer reading
170 - 177	0 - 300	Red with char, separating and flaking on specimen surface, with light surface flames
185	300	Unstable flaming about 1" off surface
194	350	This is flame spread distance at center line
206	350	Flames are out at flame front, extinguished
218		All flames are out, extinguished on specimen
225	0 - 300	No material left on specimen except for around edges of specimen holder, red with char
237	3.72mv	Pyrometer reading
520	3.67mv	Pyrometer reading
520	0 - 300	No material left on specimen except for around the edges of specimen holder, and is white char
537	300 - 450	Complete black char
545	450 - 520	Brown char
548	500	Progression of bubbles
555		The black char has covered the flame spread distance
560	3.66mv	Pyrometer reading



Material 16, Specimen 4, Laminate on Marinite Backing

TEST: M16S5SP2 Specimen Number 5  
DATE: 24 October 1987  
MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8		Explosions and flaming at impinging flame
18	50	Flaming started
21	100 - 150	Progression of bubbles
28	100	Flame front with sparks
40	150	Steady flame front about 6" height into stack
48	0 - 300	Bubbles and char, surface is exploding with sparks
53	200	Flame front, steady flaming
57	3.57mv	Pyrometer reading
64	250	Steady flame front
80 - 94	300	Steady flame front with flames steady across specimen, flames decreasing to 4" height into stack
102	3.68mv	Pyrometer reading
125	300	Flame front becoming unstable with flames decreasing in size
150	300	Flame unstable now - flame front unstable
160	0 - 200	Material is red char and starting to flake off specimen
188 - 195	300	Unstable flame front with flames at the center line and above the center line
210	350	Unstable flame about center line
215	325	Flame is out, extinguished, flame spread distance is 325mm, at center line
225	350	Still have light unstable flaming above the center line
230	0 - 250	Material has separated from backing red with char and light unstable surface flames
267	3.70mv	Pyrometer reading
280		Still have light unstable surface flames on the material around edges of holder, red char
308		All flames are out on test specimen, extinguished
315 - 323	0 - 300	No material left on specimen except for around the edges of holder, red char, flame spread distance is 325mm
332	325	Material is raised off backing but still is attached to test specimen

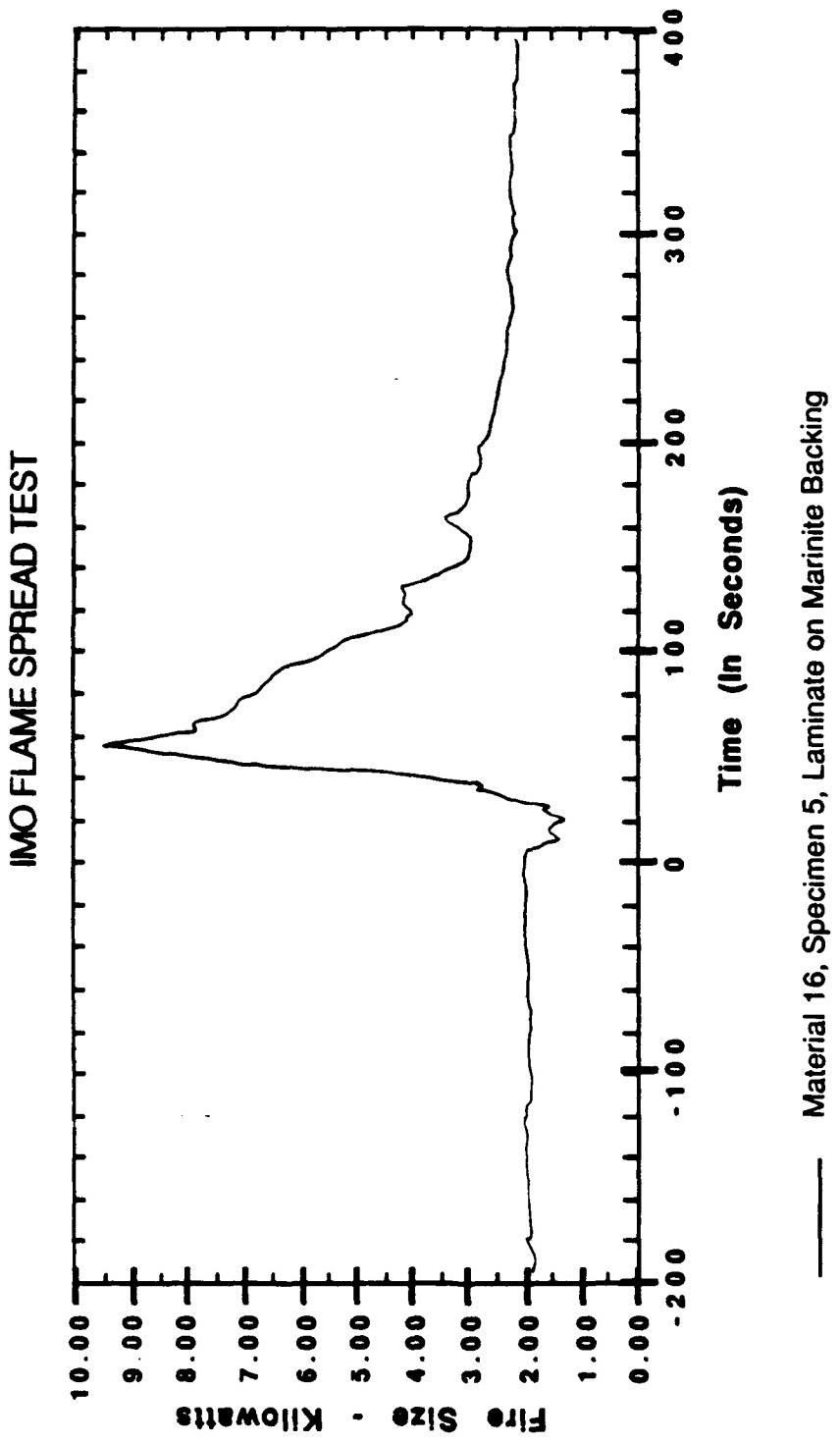
TEST: M16S5SP2 Specimen Number 5 (cont'd)

DATE: 24 October 1987

MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
520 around	0 - 325	No material left on specimen except the edges of holder turning white char
530	325 - 450	Black char line
535	450 - 525	Brown char line
545	525	Progression of bubbles
550 - 560	3.67mv	Pyrometer reading, flame spread distance is 325mm, but difficult to see because char has over taken the material



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TEST: M17S1SP2 Specimen Number 1  
 DATE: 13 October 1987  
 MATERIAL: Laminate

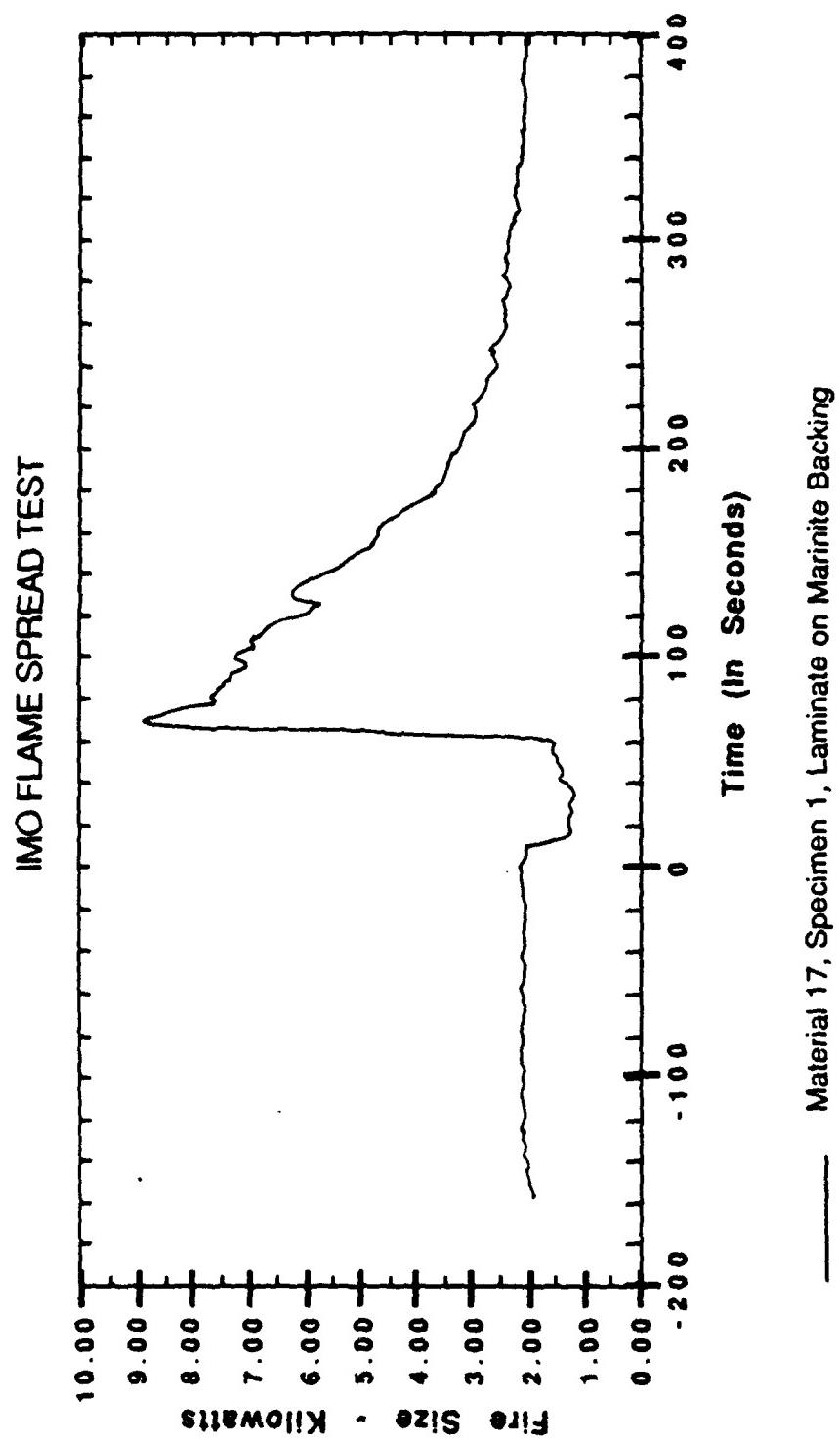
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
22	at 100	Large explosion
25	up to 150	Spontaneous explosions, heavy black smoke
30	up to 200	Explosions and bubbles
35 - 42		Explosion was 100mm dia. bubble, turning black with char up to 250mm, heavy black smoke, no flaming
50	300	Bubbles and char line
55	250	Complete black char and heavy black smoke
60-70		Spontaneous flaming up to 250mm across the face of specimen about 6" into the stack
85	300	Stable flame front with flames 6" height
142	0-100	Steady flame with material separating from backing
153	100-200	Unstable flaming
160	200-350	Unstable flaming decreasing with material separating from specimen backing and turning red char 250mm
175		Flame front with flames 4" into stack
186	350	Material is separating and falling off of specimen
210	0-300	Backing and turn red char, unstable flaming 1" height
225		Unstable flame front about 2" height off surface
232	300-350	Flaming just above center line
252	350	Still have pieces disintegrating and falling off and turning red char
270	300	Still have light flaming with material starting to separate from specimen backing
285	350	Pyrometer reading
295	3.75mv	Still have light flash flames with material separating from specimen backing and falling off
335	350	Material has totally disintegrated from specimen except from around specimen holder which is turning red char
345		
352	0-300	

TEST: M17S1SP2 Specimen Number 1  
DATE: 13 October 1987  
MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
385	350	Material has separated at this position
392	350-450	Dark brown char line
396	450-500	Light brown char line
402	525	Farthest position off bubbles
407 - 428	350	Flashing flames about 1/2" off specimen surface. Unstable material turning red char and glowing
432	3.71mv	Pyrometer reading very light smoke
465	3.70mv	All flaming has ceased with pyrometer
625	0-350	Total disintegration off the specimen with no material left on the specimen backing
635	350-450	Dark brown char line
640	450-525	Light brown char line with bubbles up to 525mm
645	3.67mv	Final pyrometer



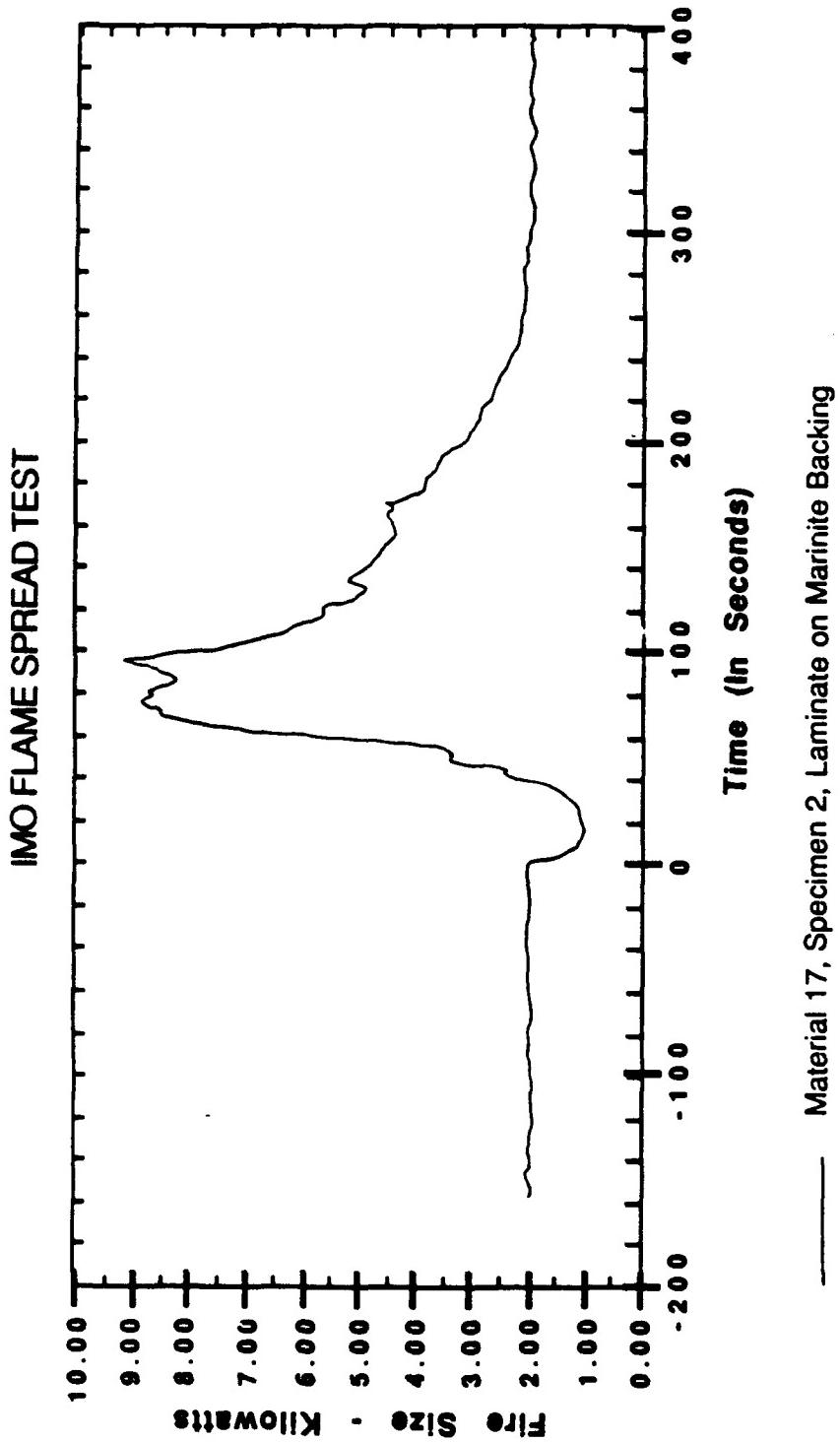
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TEST: M17S2SP2 Specimen 2  
DATE: 16 October 1987

Material: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
22	0-150	Large explosion
30	0-150	Material from explosion has separated and started to char
33	200	Bubble progression
37	0-50	Flaming above center line with moderate to heavy smoke, unstable flaming
45	100	Flame front with height 2" into stack stable flame, smoke is light
56	300	Black char line and bubbles progression
67	150	Flame front
70	200	Stable flame front 6" height in stack
85	300	Stable flame front
100	3.67mv	Pyrometer reading
110	300	Stable flame front
115	350	Black char line
120	400	Light brown char line and bubble progression
130 - 135		0-150 material has separated from specimen and red with char, and sparks, falling off specimen
142		Unstable flaming across specimen
155	200-300	Stable flame front 3" into stack
157	350	Unstable flame front
243	3.73mv	Pyrometer reading
247	350	Unstable flame front, 1" height
255 - 270	0-300	Material has disintegrated leaving an exposed backing, material around specimen holder is red char
275		Unstable flaming above and below center line decreasing
285	425	Complete black char
290	475	Brown char and bubbles
295 - 305		Flaming is out above the center line, with small unstable flame below center line at 325mm
312		All flaming has extinguished at this time
315	3.68mv	Pyrometer reading
550	0-350	No material left on specimen, fallen off
560	350-450	Dark black char line
565	450-525	Light brown char line and bubbles
575	3.64mv	Pyrometer reading



TEST: M17S3SP2 Specimen Number 3  
DATE: 19 October 1987

Material: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

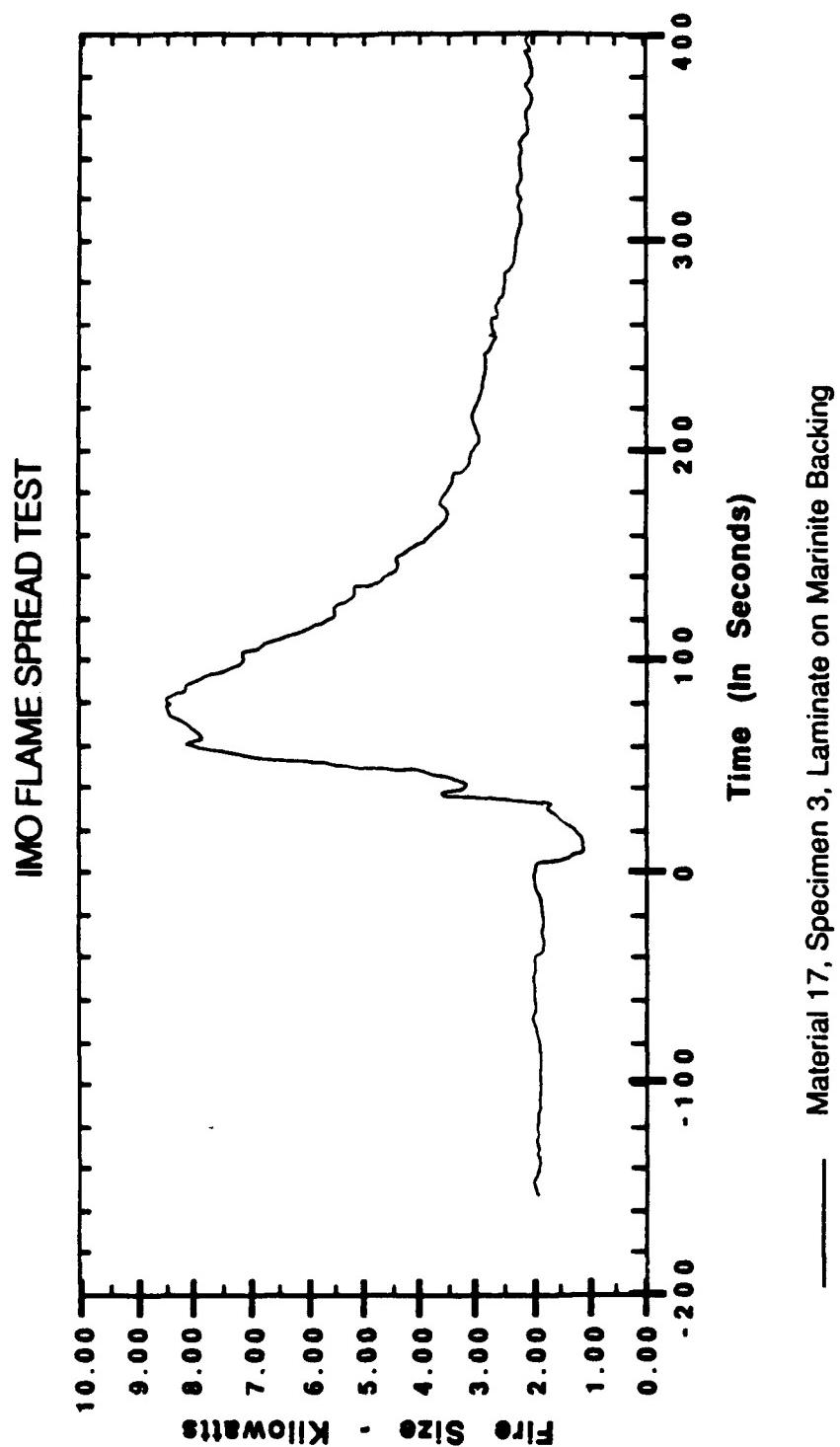
Time (sec)	Distance (mm)	Remarks
9		Charring at impinging flame
15	50	Bubbles
23	100/150	Bubbles
27	100	Black char
30	0-50	Flames moving across surface rapidly
33	100	Flame front
44	250	Bubbles and black char
47	100	Steady flame front about 4" into stack
58	150	Flame front moderate smoke
63	200	Flame front across the specimen 6" height
77	350	Bubbles across specimen black char also
97	250	Flame front
125	300	Flame front, flames decreasing to 4" height
130	400	Bubbles and black char
137	0-200	Material is separating from backing red with char
153	3.72mv	Pyrometer reading
210		Flames have decreased to 2" height off specimen surface
222	0-300	Material has separated off specimen back turing red with char with unstable flaming 1" in height
275	300	Flames had a rapid increase the decrease from escaping air from behind specimen backing 1" height
290	350	Steady flame front
300	3.73mv	
310	0-300	No material left on specimen except around edges of holder turning red char and sparks
323	300-350	Light unstable flaming with material separating from backing raised off red char
342	350	Flames out at center line, extinguished, light flames above center line by specimen holder
374		All flames are out, extinguished. 3.70mv pyrometer reading
405	340	Flame spread distance
415	3.66mv	Pyrometer reading
605	0-350	No material left on specimen except around edges of holder, white with char
612	350-450	Black char line

TEST: M17S3SP2 Specimen Number 3  
DATE: 19 October 1987

Material: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
616	450-520	Light color char line
622	450	Progress of bubbles
630	3.66mv	Pyrometer reading



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TEST: M17S4SP2 Specimen Number 4  
DATE: 23 October 1987  
MATERIAL: Laminate

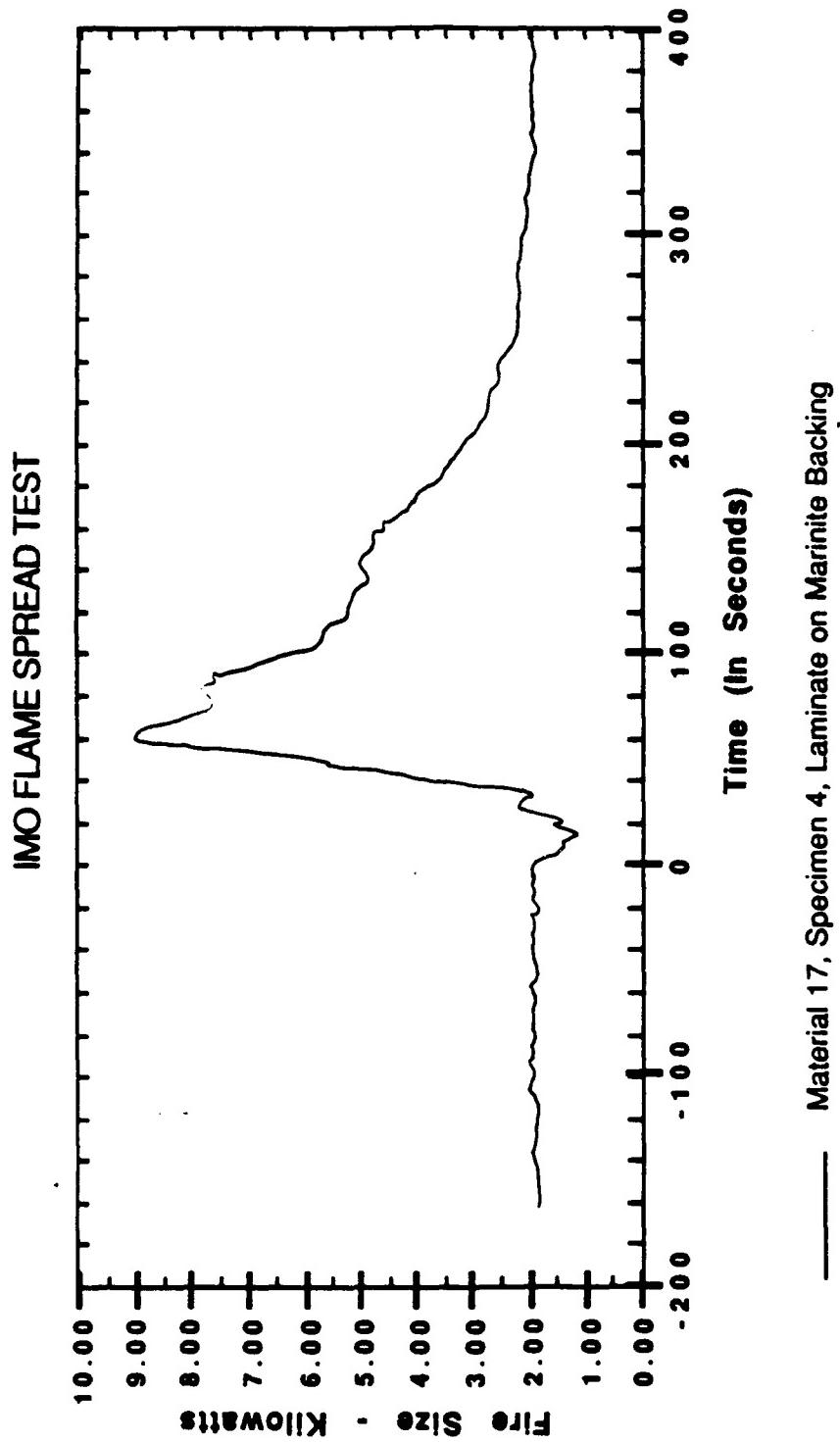
USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10		Explosion and char at impinging flame
21	50, 100	Char and bubbles
25	150	Progression of bubbles
30	50	Flaming starter
32	200	Bubbles and black char
40	100	Unstable flaming
43	100	Stable flaming steady
50	150	Steady stable flame front
54	300	Bubbles and black char
60	200	Steady flame front about 6" height into stack
67	250	Steady flame front
75	350	Bubbles and black char
84 - 90		Material has separated from its backing at the impinging flame producing sparks
115 - 120	325	Steady flame front with decreasing flames to 4" height into stack
125	400	Bubbles and black char
137	0 - 100	Material has separated from backing but still attached producing red char and sparks
156	300	Steady flame front about 4" height
167	0 - 150	Material is separating from backing can fall anytime, red char and sparks and light surface flames
178	3.75mv	Pyrometer reading
200 - 215	0 - 300	Material has separated and is falling off specimen, with red char, sparks and light surface flames
220	300	Still steady flame front but decreasing flame height about 2" into stack
230	3.68mv	Pyrometer reading
250 - 265	300	Flame front is unstable with material separating from backing and leaning toward the radiant panel, but still attached to specimen
275	325	Unstable flame front
290	0 - 300	No flames, and no material left on backing except for around edges of holder, red char
300	325	Unstable flaming, flashing on and off
325	325	Flames are out, extinguished

TEST: M17S4SP2 Specimen Number 4 (cont'd)  
DATE: 23 October 1987  
MATERIAL: Laminate

USCG -IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
330	3.45mv	Pyrometer reading
345		Low pyrometer reading because piece fell in path of pyrometer correct reading is 3.70mv
360	325	Unstable flashing flames, on and off
376	325	Flames are out, extinguished
381	3.69mv	Pyrometer reading
655	3.65mv	Pyrometer reading
665	0 - 340	No material left on specimen except for around the edges of holder, which is white char
675	340 - 450	Black char
680	450 - 525	Brown char
685	450	Progress of bubbles
687	3.65mv	Pyrometer reading



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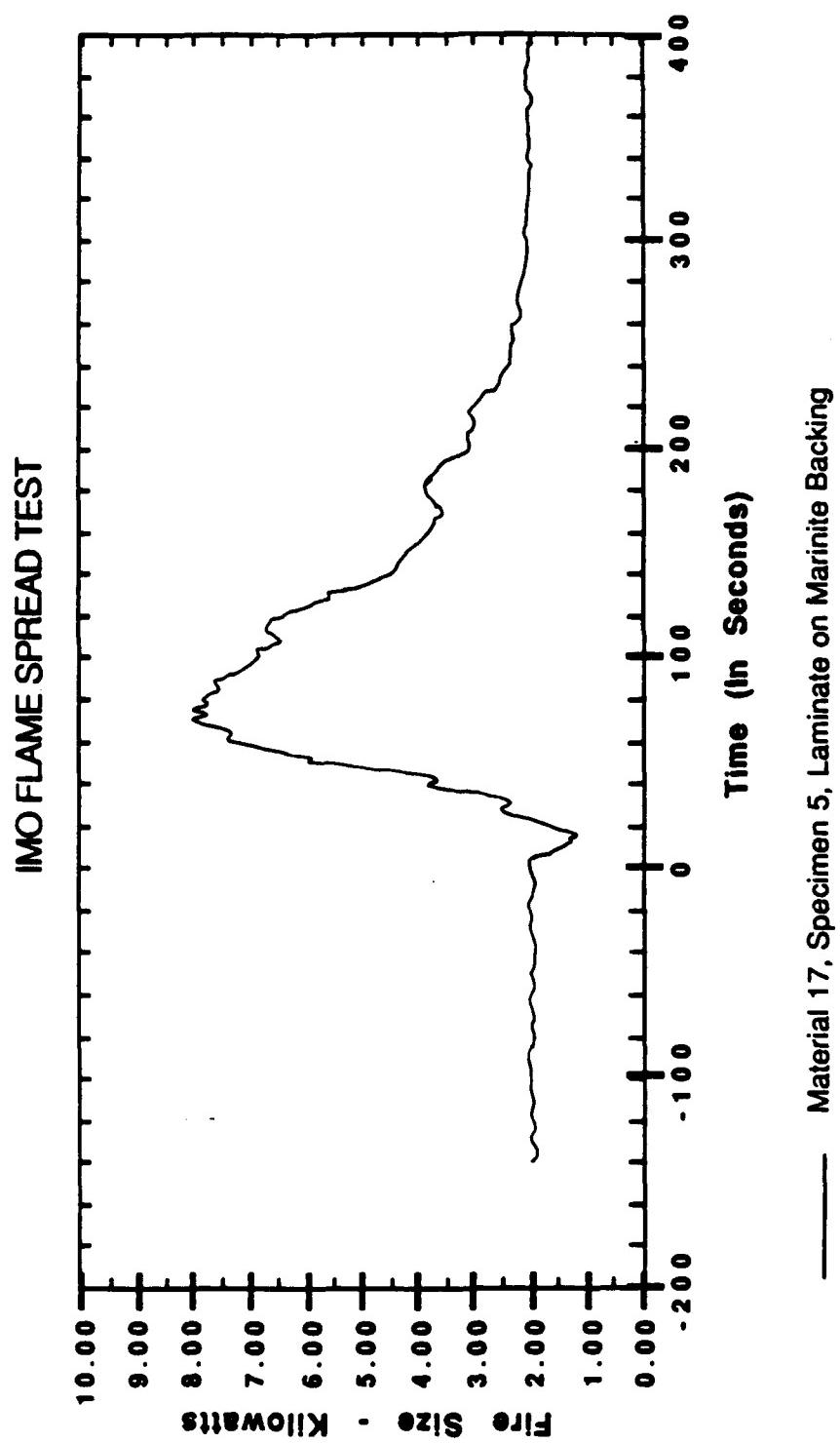
TEST: M17S5SP2 Specimen Number 2

DATE: 24 October 1987

MATERIAL: Laminate

USCG - IMO SURFACE FLAMMABILITY TEST

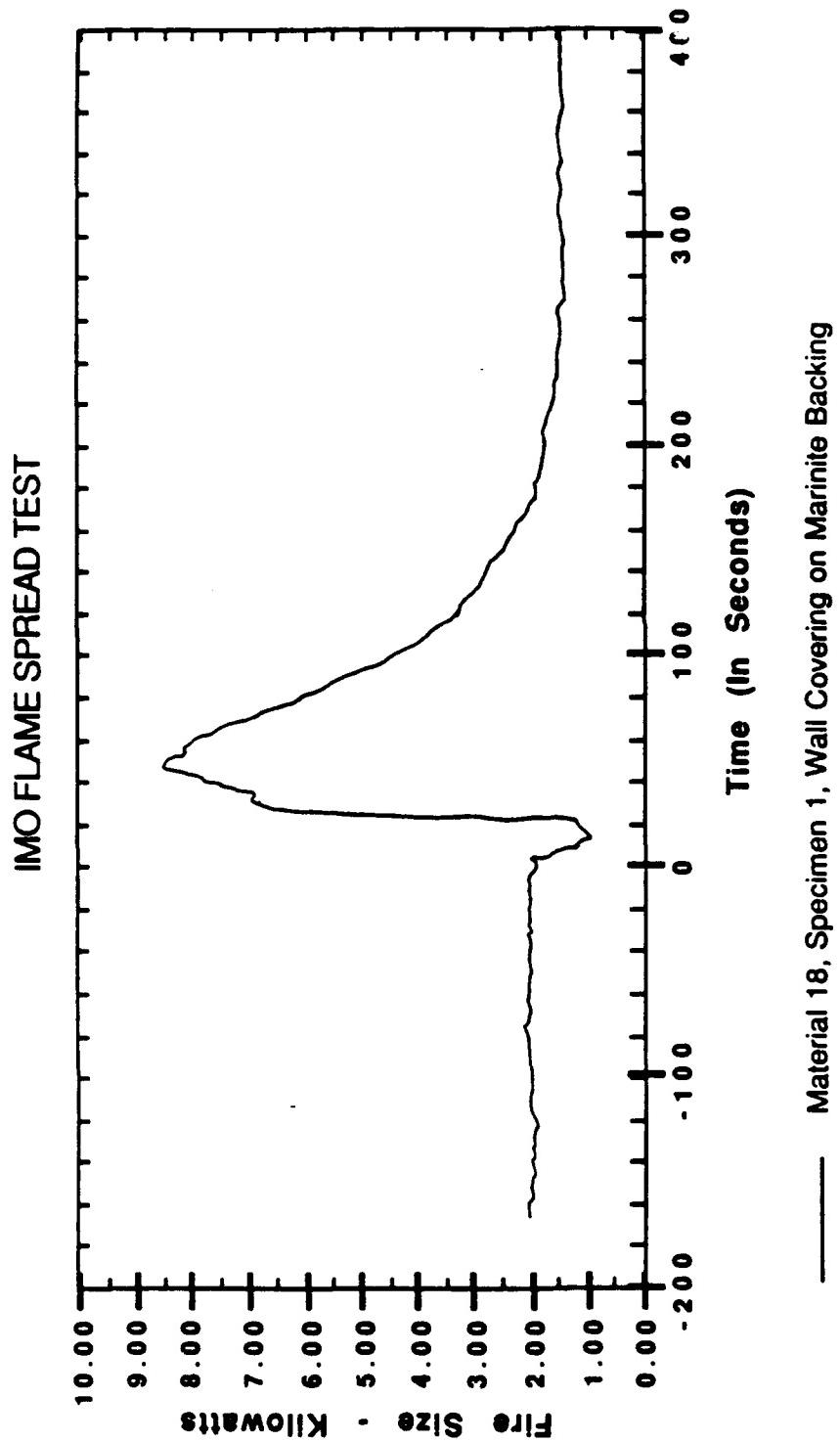
Time (sec)	Distance (mm)	Remarks
8		Explosions and flaming at impinging flame
22	50, 100-150	Progression of bubbles
25	50	Start flaming
28	200	Bubbles progression
35	100	Flame front
47	150	Flame front
58	200	Flame front steady about 6" height into stack
95 - 115	300	Steady flame front with flame size about 4" - 6" into stack with material starting to separate at 50mm flake off
120	400	Bubbles and black char
131	250	Flame spread distance
145		Material is separating and flaking off specimen with red char and sparks
155	300	Flame front starting to decrease in size but still steady
168	3.71mv	Pyrometer reading
204	0-300	Material has separated from specimen backing with decreasing flame height
211		Flame front is starting to become unstable
220	350	Flame front
235	3.73mv	Pyrometer reading
250	350	Flame front unstable with flames about 2" in height, flashing
290	350	Flame front is out, extinguished
320	3.70mv	Pyrometer reading
525	3.68mv	Pyrometer reading
533	0-350	No material left on specimen except for around edges of specimen holder, white with char
544	350-450	Black char line
548	450-520	Brown char line
551	520	Progression of bubbles
555 - 567		Flame spread distance 350mm but line is no longer present on specimen because black char has progressed to cover it over
572	3.67mv	Pyrometer reading



TEST: M18S1SP2 Specimen Number 1  
 DATE: 13 October 1987  
 Material: Wall Covering

**USCG - IMO SURFACE FLAMMABILITY TEST**

Time (sec)	Distance (mm)	Remarks
10	0 - 350	Spontaneous bubbles across the specimen
16	200	Spontaneous flaming up to this position. Heavy black char, flaming 6" into stack
23	0 - 450	Steady flaming, bubbles across specimen
30	0-350	Steady flaming across the surface
48	0 - 500	6" into stack, bubbles
54	3.73mv	Pyrometer reading
72	0-150	Unstable flaming that is decreasing sharply
85	150-450	Unstable flaming decreasing gradually
100	450	Flame front distance
118	0-350	No flames
122	350-450	Unstable flame front, 4" into stack
130	550	Surface bubbles up to this position
138	3.66mv	Pyrometer reading
170	400-500	Unstable flashing flames
185	1-200	Surface material turning white char
197	200-450	Complete back char across specimen
205	450	Flashing flames passing center line
220	at 475mm	moving upward to 500mm 1/2" off surface
227		Very light smoke
	3.65mv	Pyrometer reading
260	500	Still have flashing flames above center line
285	0-300	Specimen completely white with char
290	300-475	Area of complete black char across specimen
292		Flaming is out at this time on specimen, light smoke
305	625	Bubbles up to this position
325	425	Flame spread distance at center line
336	3.64mv	Pyrometer reading
540	0-300	Specimen complete white char
555	300-450	Complete black char
570	450-500	Light brown char
576		Bubbles above and below center line
590		Flame spread distance
600		Final pyrometer



— Material 18, Specimen 1, Wall Covering on Marinite Backing

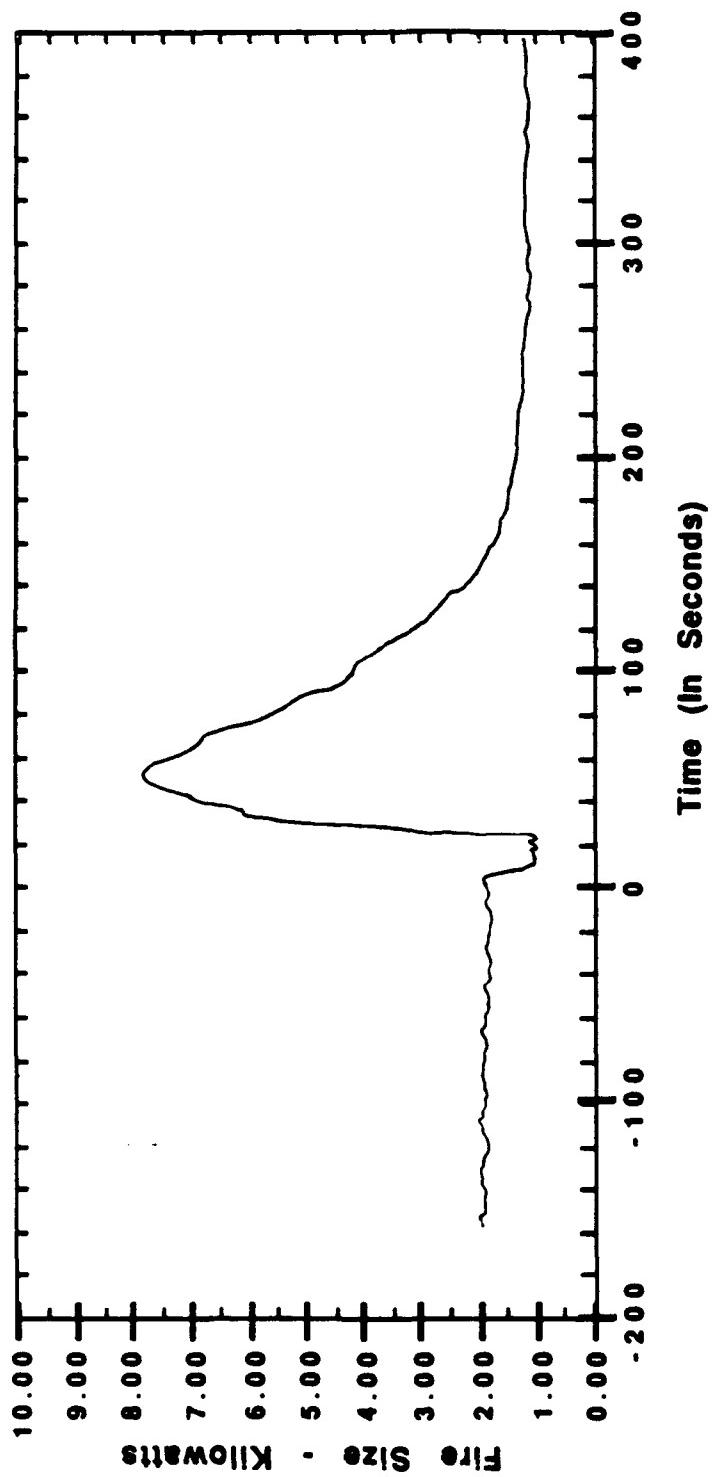
TEST: M18S2SP2 Specimen Number 2  
DATE: 16 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8		Spontaneous bubbles up to 250-300mm light smoke
13	200	Flaming across specimen
14	250	Flame front
17	300	Flame front
30	350	Flame front unstable, 6" height into stack
50	500	Bubble progression
60	400	Flame front
65	3.70mv	Pyrometer reading
68		Flame front is unstable flaming
73	0.50	Unstable flaming
85	50-200	All flames have extinguished
92 - 105	200-400	Steady flaming decreasing to unstable flaming about 4" into stack
107	575	Position of bubbles
135 - 144	400	Flame spread distance with unstable flaming flashing on and off 3" height into stack
151	3.65mv	Pyrometer reading
167		Flames have extinguished. Final position of flame spread distance of 475mm, light smoke
183	0-200	White char across face of specimen
189	200-475	Black char
196	475-600	Bubbles across face of specimen
202	3.64mv	Pyrometer reading
495	0-250	Specimen has turned white char
500	250-475	Dark black char line
525	475-500	Light brown char line
533	475-650	Bubbles across specimen
540	3.62mv	Final pyrometer reading

**IMO FLAME SPREAD TEST**



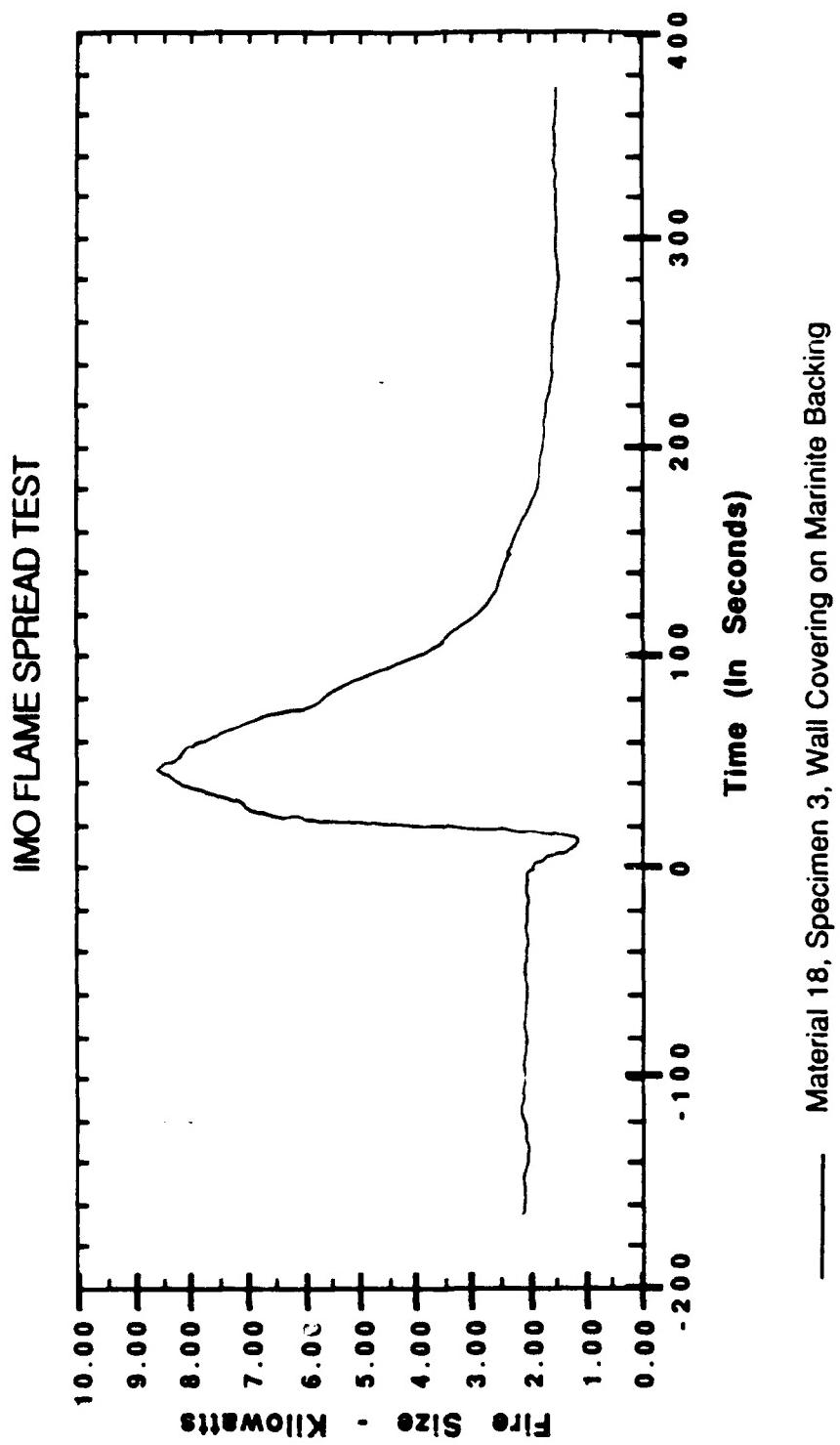
— Material 18, Specimen 2, Wall Covering on Marinite Backing

TEST: M18S3SP2 Specimen Number 3  
DATE: 19 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	100,150,200	Spontaneous flaming
14	250	Flame front
19	300	Flame front
30	350	Flame front
35	0-300	Steady stable flaming 6" height
45	300-350	Unstable flame front
53	525	Progression of bubbles
60	350	Flame front and black char line
65	3.69mv	Pyrometer reading
72	350	Unstable flame front
80	0-200	No flames
85	200-300	Steady flames decreasing rapidly
95	300-350	Unstable flame front 4" height
110	0-300	No flames
115	300-400	Unstable flaming
127	450	Flame front at center line, decreasing rapidly
140	3.63mv	Pyrometer reading
152		Flames are flashing on and off
155		Flames are out, extinguished
160	3.63mv	Pyrometer reading
170	460	Flames spread distance
470	3.62mv	Pyrometer reading
484	0-300	White char across specimen
488	300-460	Black char
497	460-500	Light black char
503	460-700	Bubbles across specimen
510	460	Flame spread distance
520	3.62mv	Pyrometer reading



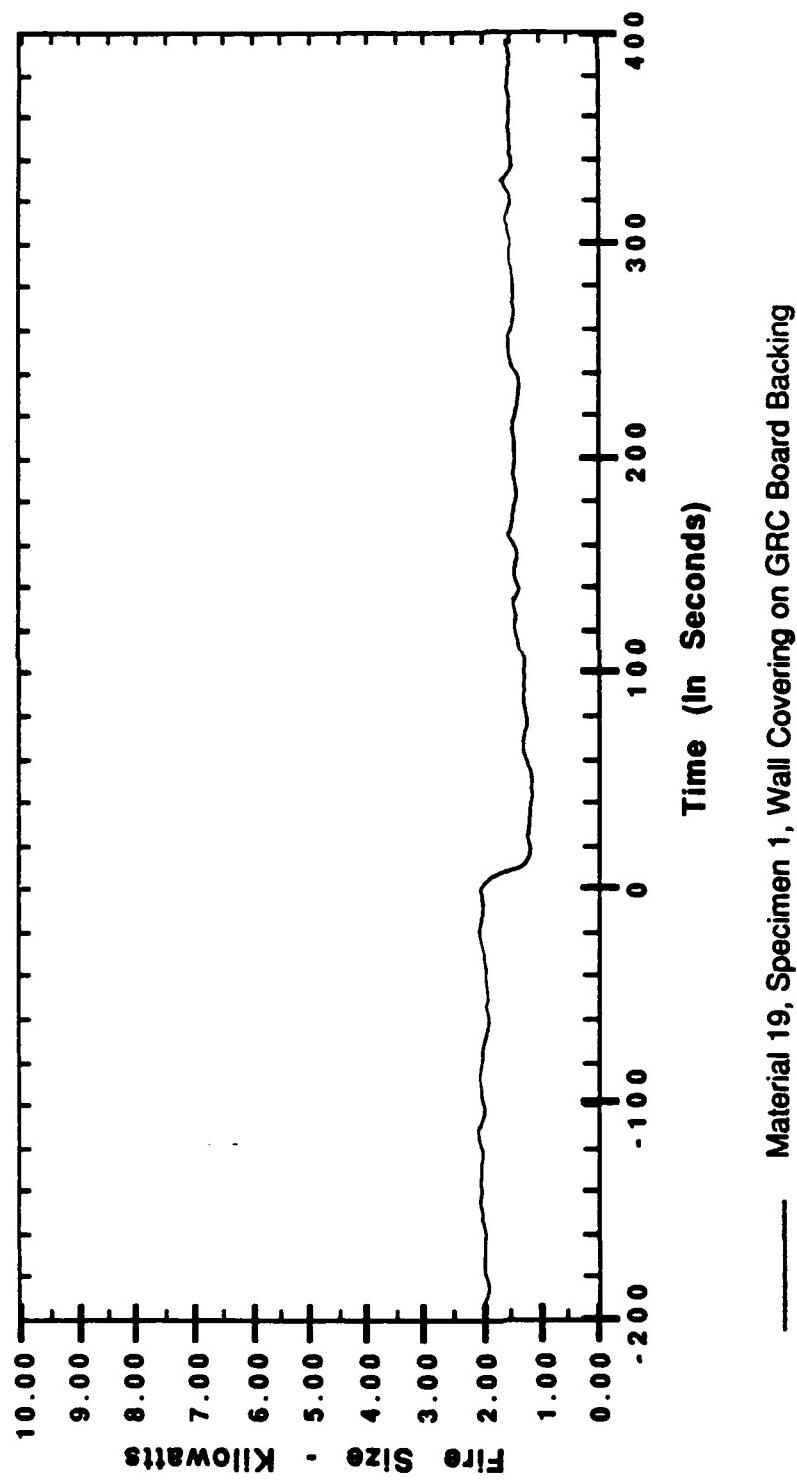
TEST: M19S1SP1 Specimen Number 1  
DATE: 13 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
12	0-150	Spontaneous smoking and bubbles
27	0-200	Surface turn back char and bubbles
35		Heavy black smoke
40-45	250	Position of surface bubbles, black char and heavy black smoke
60	0-200	Black char is forming a crust on specimen above and below center line
70	200-300	Black char on specimen, light smoke, no flaming at this time
95	0-250	Crust is turning to a dark black char and surface is alligated
105	250-325	Light black char
110	350	Position of bubbles, light smoke
120	3.46mv	Pyrometer reading
155	300	Dark black char line, surface crusted
165	350	Black char line
170	400	Bubbles and light smoke
175		No Flaming
320		No Flaming, Light Smoke
325	350	Dark black char line
330	350-400	Light black char line
335	400-450	Position of surface bubbles above and below center line
340 - 355	0-200	White char on top of material that had crusted and alligated the length
360	3.51mv	of char line Pyrometer reading
640		Test complete, No Flaming

IMO FLAME SPREAD TEST

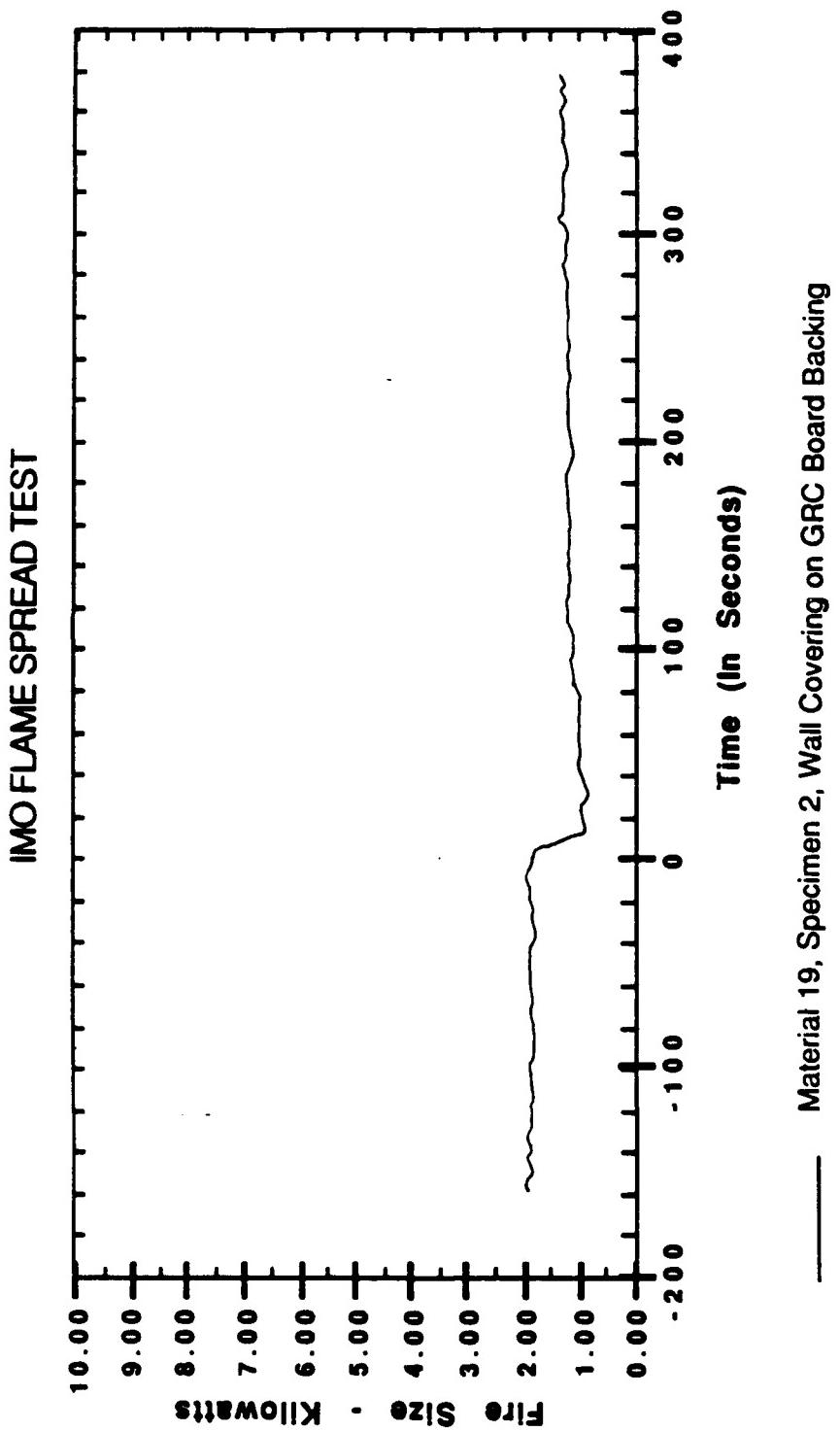


TEST: M19S2SP1 Specimen Number 2  
DATE: 15 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
15	0-150	Moderate smoke turning to heavy smoke
20	0-150	Light char forming
25	0-200	Smoke increasing to heavy, with black char
43	200	Dark brown char line
45	250	Light brown char line
50		Heavy black smoke no flame
60		Black char forming crust on surface, heavy smoke
68	300	Light brown char line, no flame
75	250	Dark brown char line, no flame
100	3.46mv	Pyrometer, no flame
186	300	Moderate smoke with black char and crust
195	375	Light brown char line
200	400	Progression of bubbles
222	3.48mv	Pyrometer reading
280	0-300	Black char and crust, light smoke
287	300-400	Light to moderate smoke, light brown char line
295	450	Bubbles progression
300	0-100	Surface of black char is turning to white char
305	3.50mv	Pyrometer reading
428	0-150	Black crust turn to white char on surface
440	150-400	Black char that has crusted
448	350-425	Light brown char line
455	425-550	Progression of bubbles
462	3.54mv	Final pyrometer reading

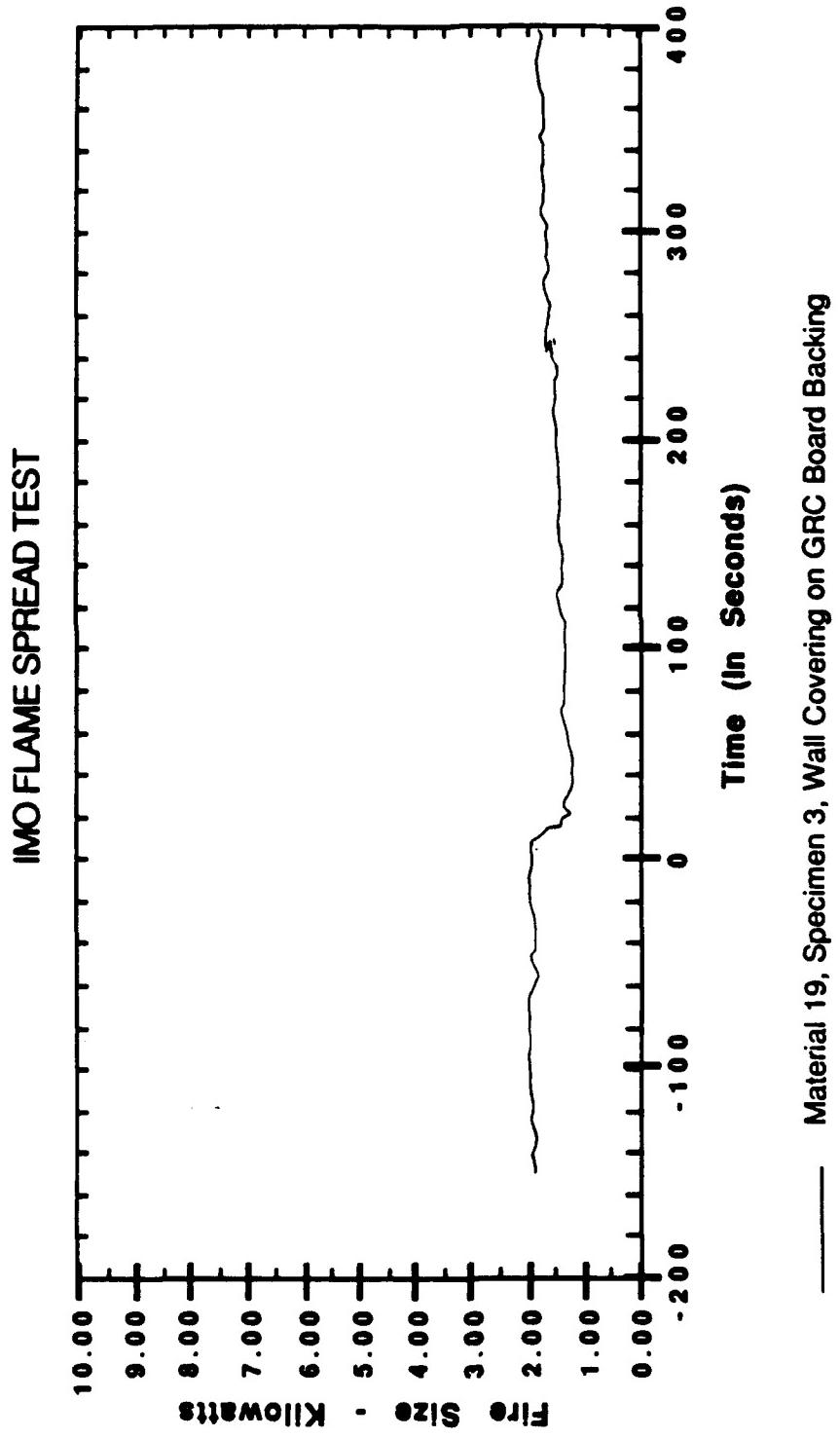


TEST: M19S3SP1 Specimen Number 3  
DATE: 19 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

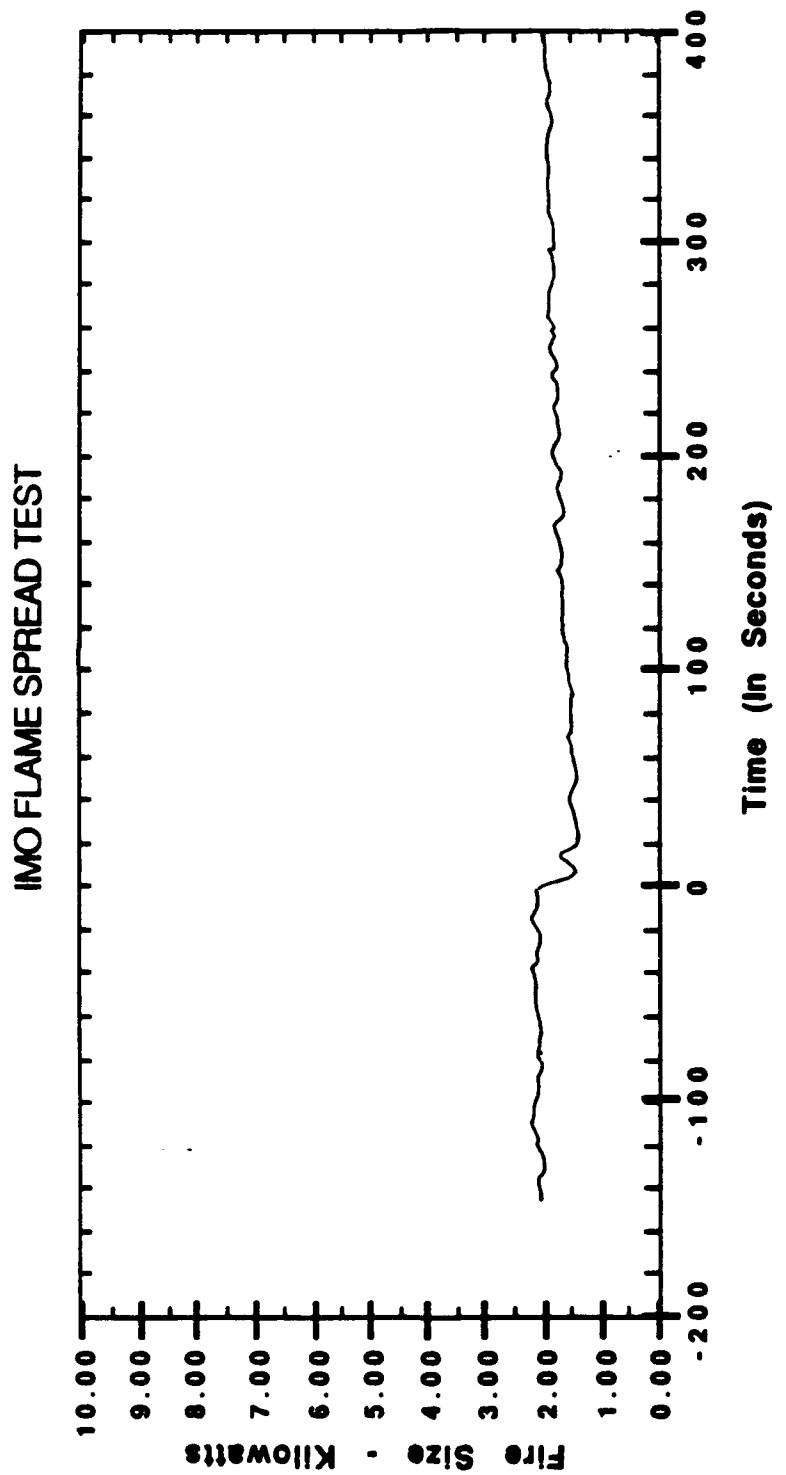
Time (sec)	Distance (mm)	Remarks
8		Flaming at impinging flame, black char
14		Moderate smoke
20	150	Black char and bubbles
26		Heavy smoke
33	250	Bubbles across specimen
37	200	Black char line
48		No flaming
55	300	Bubbles across specimen
61	200	Black char line
65	200-250	Light black char line
70	0-200	Black char is turning to a crust on surface
75		Moderate smoke
100	3.45mv	Pyrometer reading, still no flaming
128	0-300	Black char and surface crust
293	3.50mv	Pyrometer reading
304	0-300	Black char and crust
310	300-400	Light brown char
315	350-410	Bubbles across specimen
320		No flaming on this test
562	3.59mv	Pyrometer reading
572	0-200	Complete white char across specimen
577	200-400	Complete black char and crust and crack
583	400-420	Light brown char
587	420	Progression of bubbles. No flaming on this test



TEST: M19S4SP1 Specimen Number 4  
DATE: 23 October 1987  
MATERIAL: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8		Flaming and char at impinging flame
25	50	Black char
28	50 - 150	Light brown char and heavy smoke, no flaming
40	200	Black char and heavy smoke
45	250	Progress of bubbles
55	250	Black char and heavy smoke, with some smoke escaping from stack exhaust, no flaming
64	0 - 100	Black char turning to crust on surface
75	100 - 250	Black char
78	250 - 300	Progression of bubbles
80	3.45mv	Pyrometer reading
110	0 - 250	Black char is crust on surface
115	250 - 325	Black char, moderate smoke
125	325 - 350	Bubbles still no flaming
326	3.49mv	Pyrometer reading
335	0 - 325	Black char has crusted on surface
342	325 - 375	Light black char
347	375 - 425	Progression of bubbles
355	3.51mv	Pyrometer reading
535	3.55mv	Pyrometer reading
545	0 - 200	Crust on surface white with char
552	200 - 350	Crust and black char
558	350 - 425	Light brown char
565	425 - 550	Progression of bubbles
571	3.56mv	Pyrometer reading

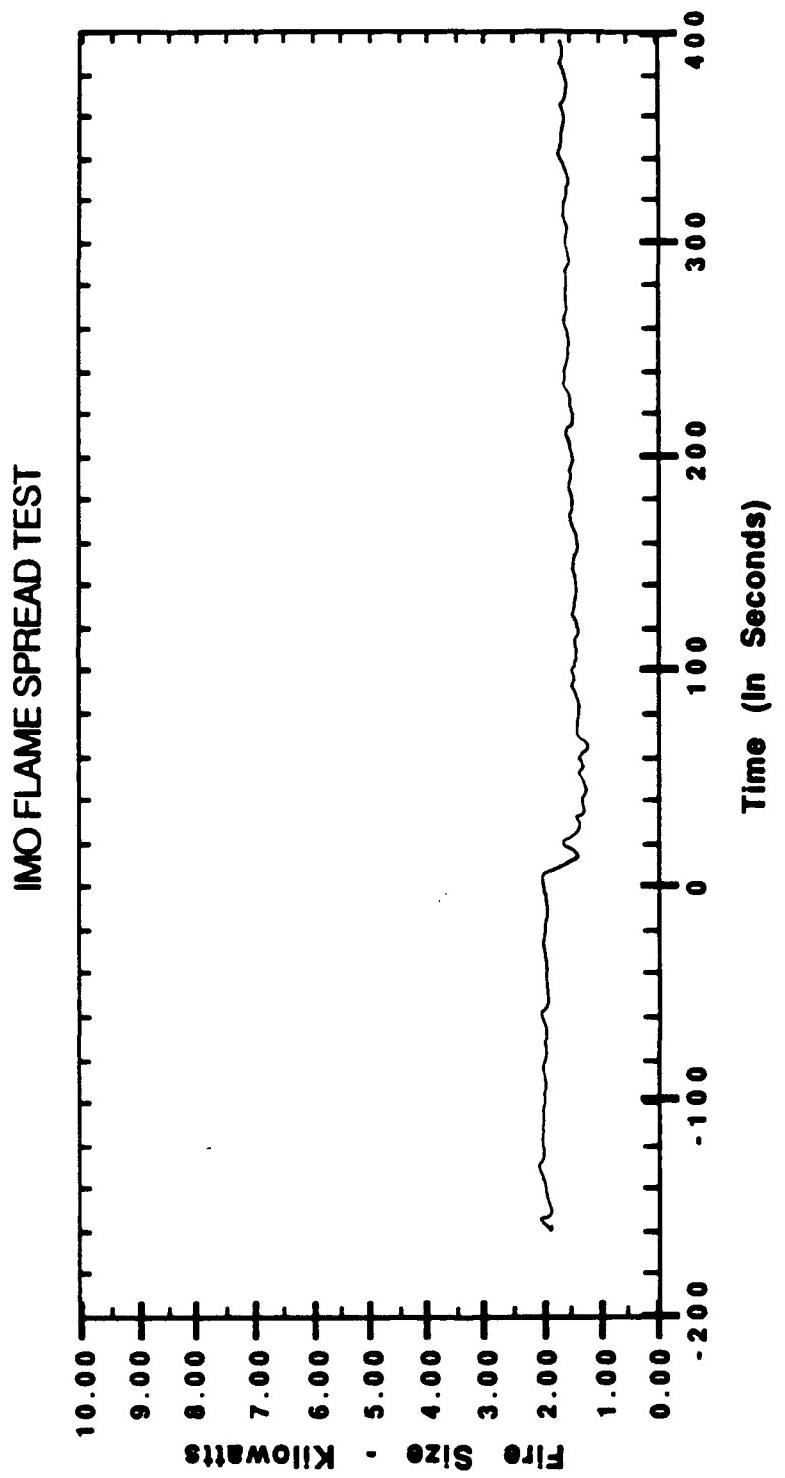


Material 19, Specimen 4, Wall Covering on GRC Board Backing

TEST: M19S5SP1 Specimen Number 5  
DATE: 24 October 1987  
MATERIAL: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
15	up to 200	Charring at impinging flame with smoke
21	0 - 100	Flashing flames on and off
30	250	Black char
34		Heavy smoke with some smoke escaping from stack
47	3.44mv	Pyrometer reading
61	0 - 150	Black char is crusting on surface
70	150 - 250	Black char and heavy smoke escaping, no flames
97	0 - 250	Black char that turns to crust
102	250 - 325	Black char
107	350	Progression of bubbles
112	3.45mv	Pyrometer reading
325	3.50mv	Pyrometer reading
335	0 - 300	Black crust on surface
340	300 - 400	Black char
345	300 - 410	Progression of bubbles
492	3.55mv	Pyrometer reading
552	0 - 250	Material is white char on top of crust
558	250 - 350	Crust on specimen and black char
563	350 - 400	Brown char
566	450	Progression of bubbles
572	3.56mv	Pyrometer reading



Material 19, Specimen 5, Wall Covering on GRC Board Backing

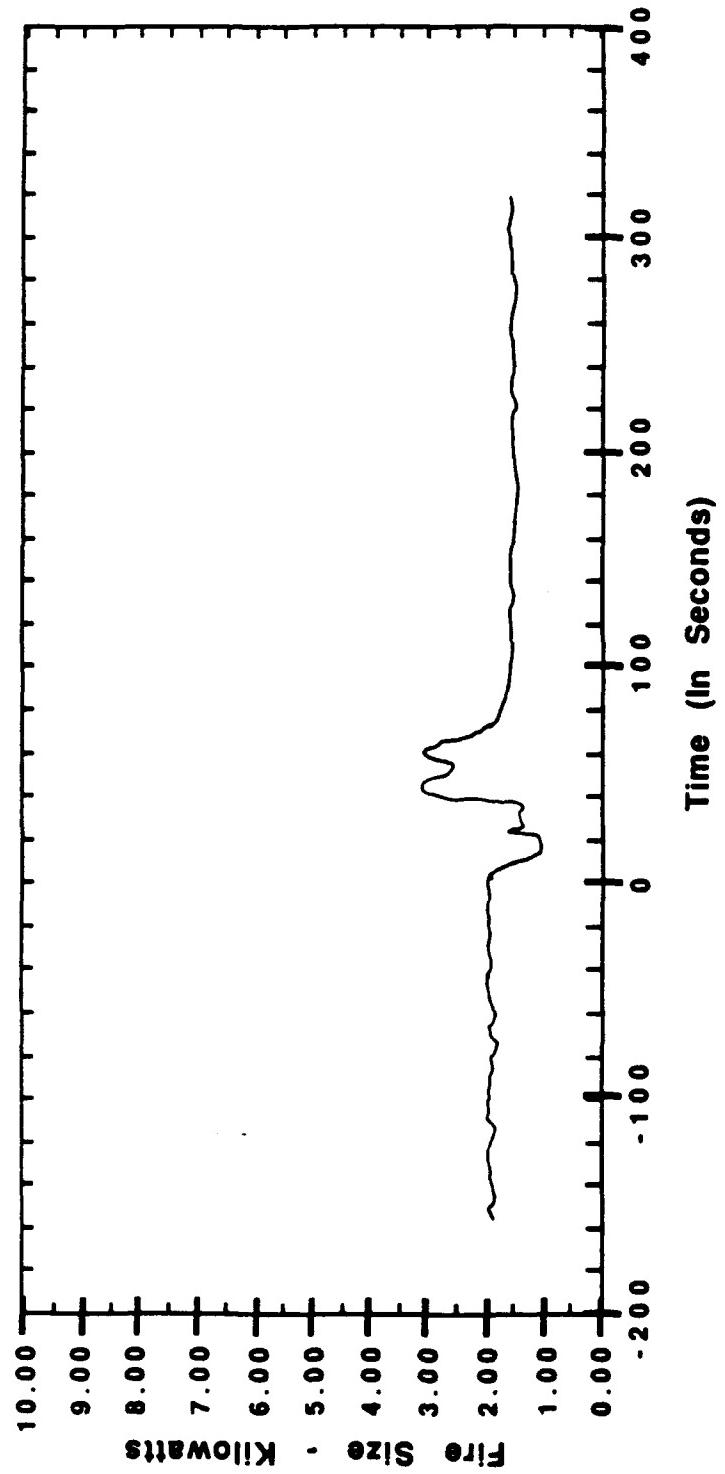
TEST: M19S1SP2 Specimen Number 1  
DATE: 13 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	150-200	Material has moderate smoke
12	250	Spontaneous bubbles, heavy black smoke and char
20	350	Progression of bubbles, heavy black smoke
27-35		Surface starting to alligator with spontaneous unstable gaseous flames across specimen up to 200mm

IMO FLAME SPREAD TEST



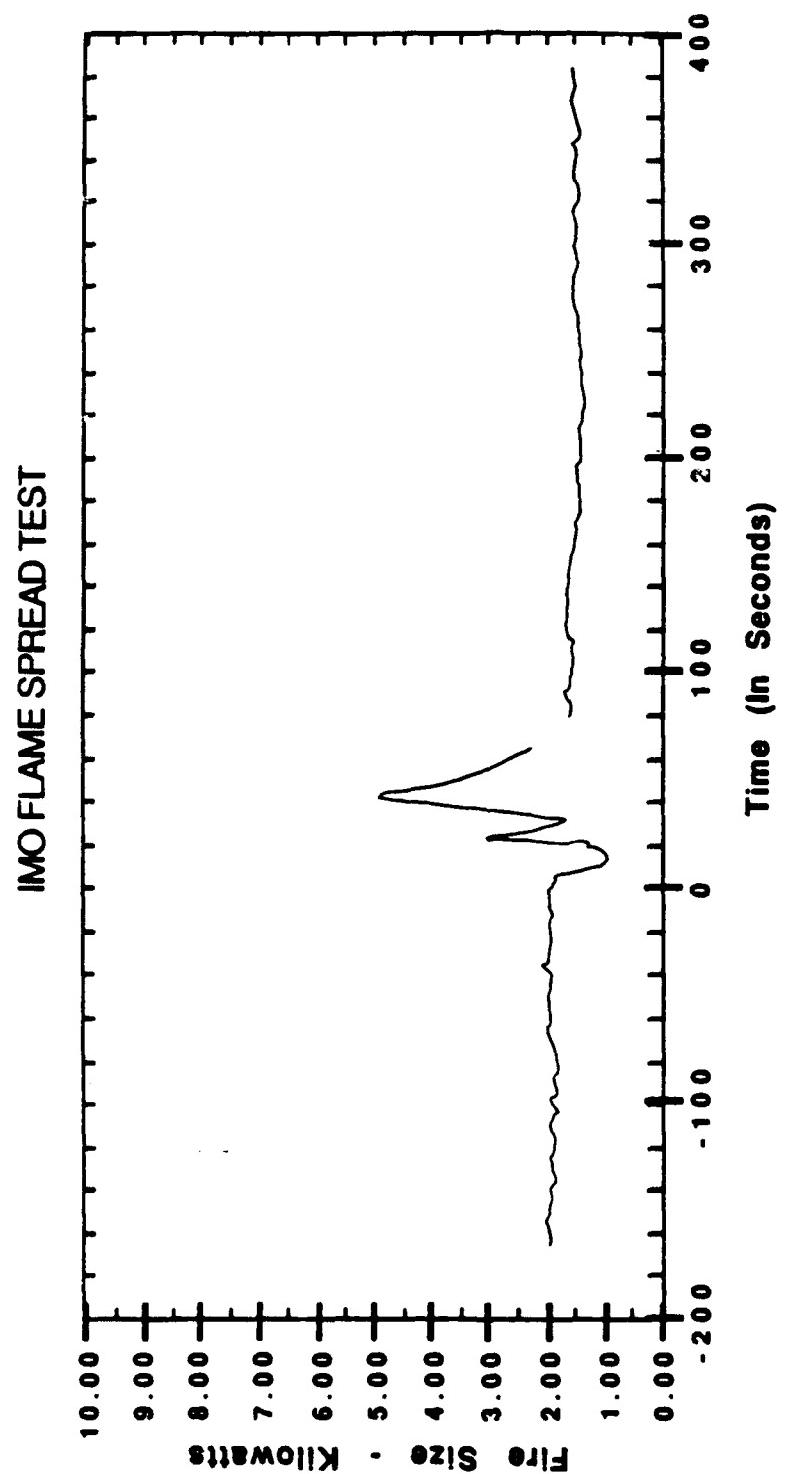
— Material 19, Specimen 1, Wall Covering on Marinite Backing

TEST: M19S2SP2 Specimen Number 2  
DATE: 16 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	0-200	Smoking
11	0-150	Flaming flashing
13	200	Unstable flaming progressing rapidly
17	250	Flaming is out extinguished, heavy smoke
23	0-250	Material is turning black char and cracking
27 - 35		Flaming on top of specimen holder, gases from specimen, flames about 2" height, progression up to 200mm.
45	250	Flames across specimen, flames unstable
70		Flaming is out now, extinguished
91	325	Flame spread distance
95	350-400	Light to moderate smoke
100	450	Bubbles across surface
105	3.59mv	Pyrometer reading
110 - 116	0-200	Material is turning white char and separating from specimen backing
120	200-350	Complete black char and surface cracks
125	350-475	Light brown char line
134	425-560	Bubbles across specimen
455	0-250	Material has separated from backing and starting to fall off and turning white char
470	250-300	Is white char and still intact
490	300-450	Black char
495	450-500	Light black char
497	410	Bubbles across specimen
500	3.62mv	Final pyrometer reading



— Material 19, Specimen 2, Wall Covering on Marinite Backing

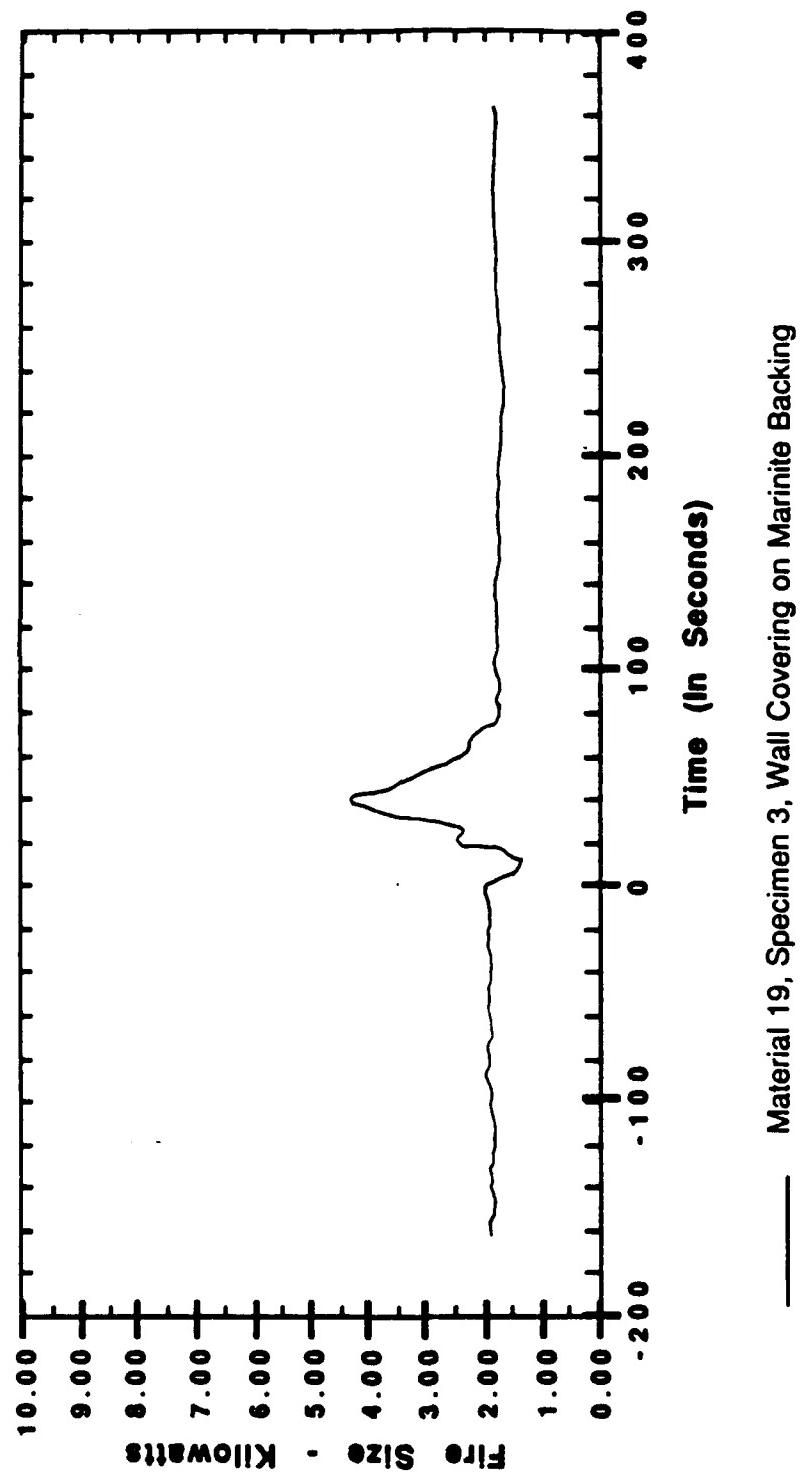
TEST: M19S3SP2 Specimen Number 3  
DATE: 19 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	100, 150	Spontaneous flaming
11		Flame out, extinguished
15		Flaming only at 50mm at impinging flame
18	200	Black char
20	250	Bubbles across specimen
25		Flaming flashing across specimen on and off
28	100, 150	Spontaneous steady flaming
35	200	Flame front steady 4" height into stack
45	250	Steady flame front
53	0-200	Flames out, extinguished
57	250	Unstable flame front
65		Flame front, flames decreasing rapidly
70	350	Flame front flashing on and off
78		Flames are out, extinguished
83	3.58mv	Pyrometer reading
97	350	Black char line and light smoke
100	400	Light color char line
103	450	Progression ob bubbles across specimen
445	3.50mv	Pyrometer reading
457	0-200	No material left on specimen
462	200	Material still attached to specimen and turning white char
470	200-300	White char
475	300-450	Black char
480	450-500	Light color char
485	500	Progression of bubbles

IMO FLAME SPREAD TEST



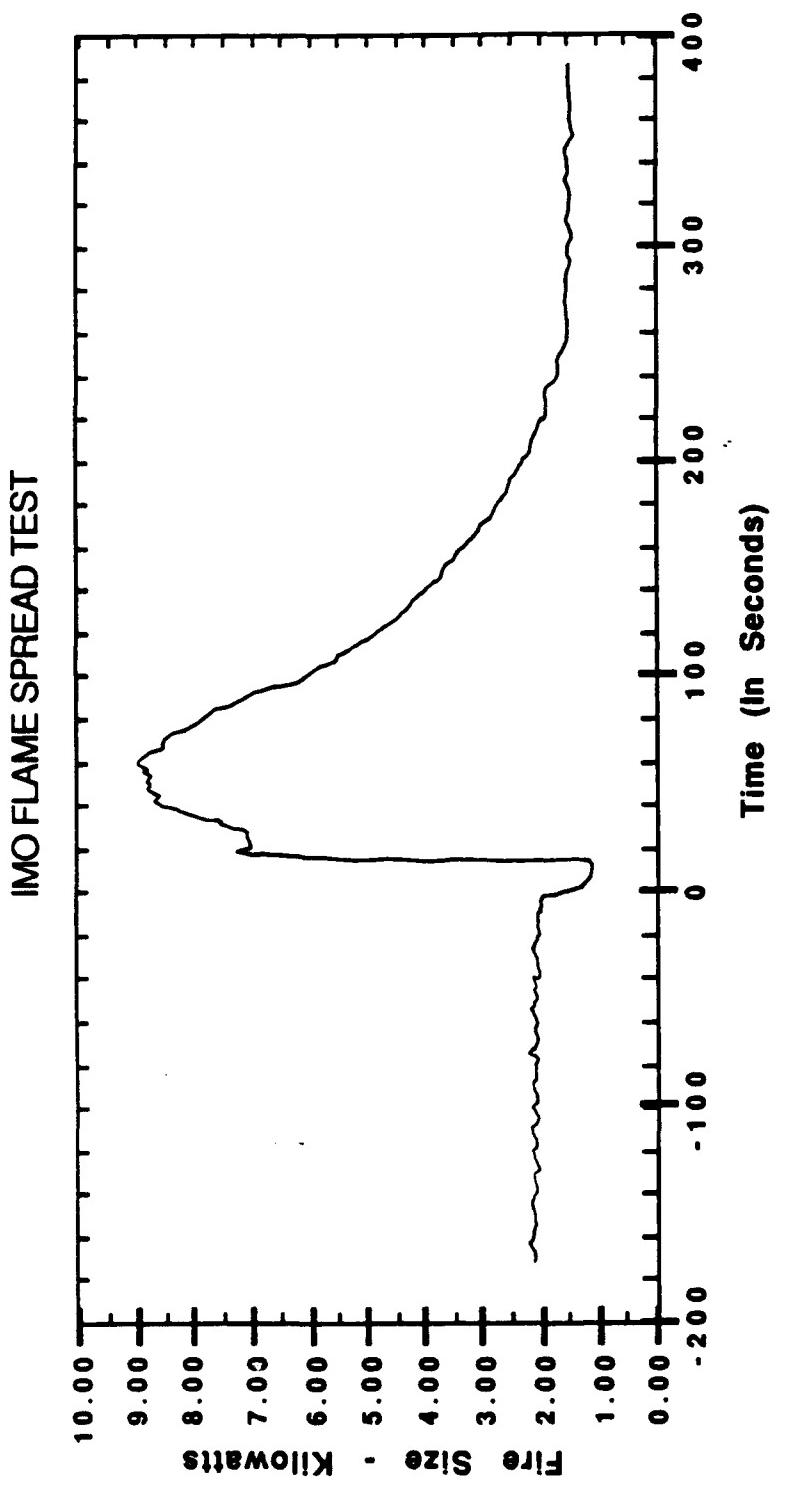
— Material 19, Specimen 3, Wall Covering on Marinite Backing

TEST: M20S1SP2 Specimen Number 1  
DATE: 14 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10	250	Spontaneous smoking, charring and flames
20	300	Flame front
27	350	Flame front across the face of specimen
35	450	Flame front with flames about 6" height
45 - 52	450	Flame front starting to be unstable and slowly progressing
60	350-450	Flame is very unstable
75	0-350	Steady flaming across specimen 6" height
80		Flame front still unstable at this time
87	3.75mv	Pyrometer reading
120	0-150	No flames
130	150-250	Flames are decreasing sharply
145	450	Flame front with flames height 4"
147 - 155		Flame front progressing to 500mm above center line, flame front is unstable flickering on and off. Flames have decreased to 3" height.
155		
165	0-300	No flames
175 - 260	300-475	On center line. You have an unstable flame front about 3" into stack
	350-450	unstable flaming decreasing 2" height
275	490	Flame spread distance on center line with light smoke
	3.62mv	Pyrometer reading
305		All flaming has ceased at this time, light smoke
325	3.62mv	Pyrometer reading
365		An exposed backing
370 - 387	225-500	Charred specimen with alligatoring light smoke
407	500	Flame spread distance
540 - 545	0-300	Material has fallen off specimen leaving an exposed backing
550	300-500	Complete back char with flame
557		Spread distance at 500mm with alligated surface
570	510	Light char line
580	3.62mv	Pyrometer reading



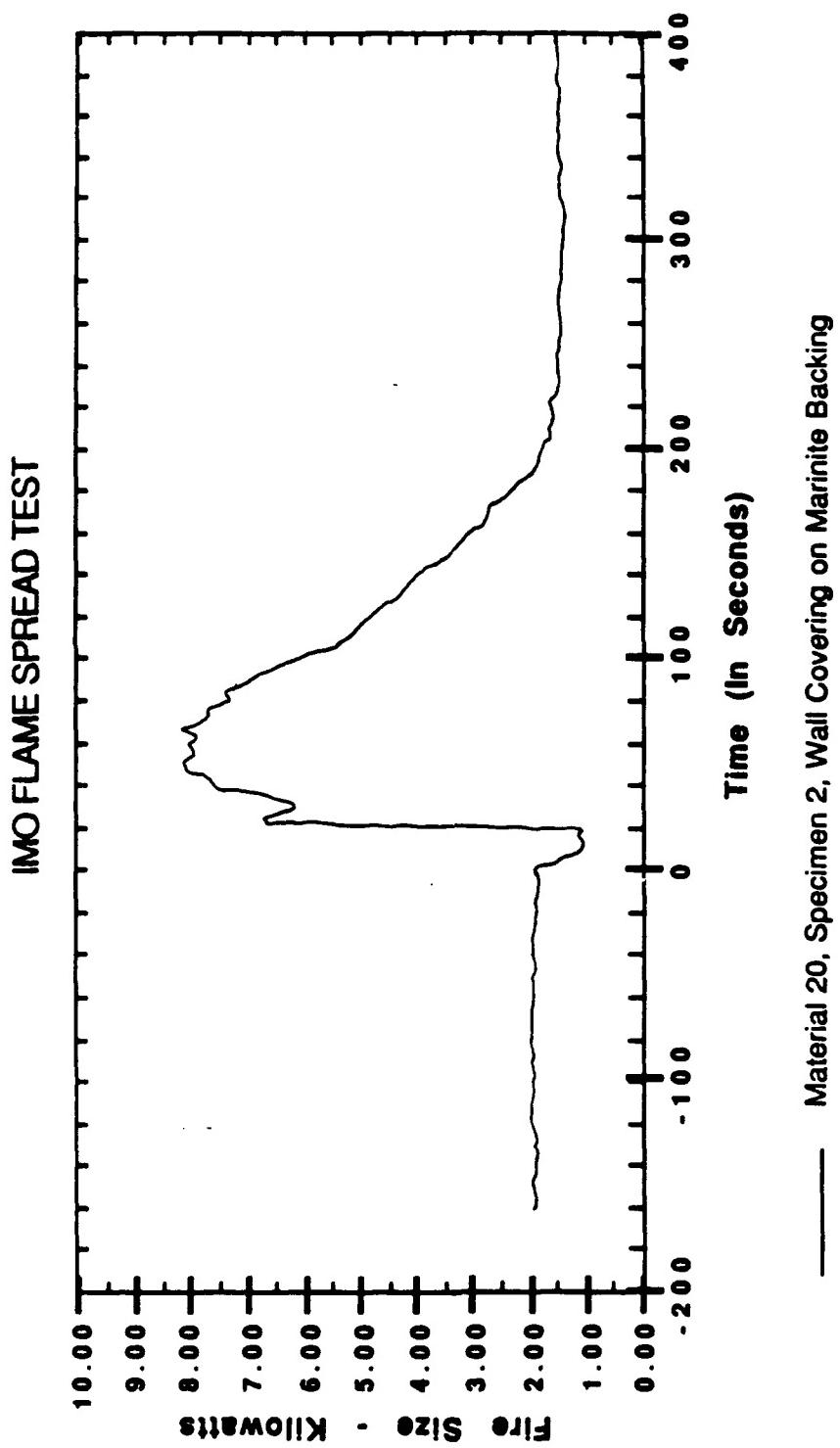
Material 20, Specimen 1, Wall Covering on Marinite Backing

TEST: M20S2SP2 Specimen Number 2  
DATE: 15 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7	0 - 300	Spontaneous bubbles
10	0-300	Smoke then spontaneous flaming
15	350	Flame front with flames reaching 4-8" in stack
25	350	Stable flame front
34	400	Stable flame front
40	0-400	Steady flames about 6" into stack
55	0-400	Stable and steady flames
60	400-450	Stable flames becoming unstable with flame front reaching 450mm
78	0-300	Steady flaming across specimen
90	400	Unstable flame front, flashing on and off
95	0-300	Steady flaming with material starting to fall off
130	0-200	No flame, material has fallen off of specimen backing
140	200-400	Unstable flames decreasing sharply
150	400	Unstable flame front, flashing on and off
164	3.67mv	Flames decreasing rapidly
205	400	Pyrometer reading
210	3.64mv	Unstable flaming flashing on and off
225		Pyrometer reading
		Flames are out at this time, extinguished
229		Light smoke
248	0-200	No material left on specimen
260 - 265	200-300	Material is separating from specimen, could fall at any time
270 - 283	300-490	Dark black char line with surface cracks, 490mm is flame spread distance
283		
453	0-200	No material left on specimen
458	200-300	Material has separated but still attached to sample
472	300-500	Brown char line
477	490	Flame spread distance
485	600	Final progression of bubbles

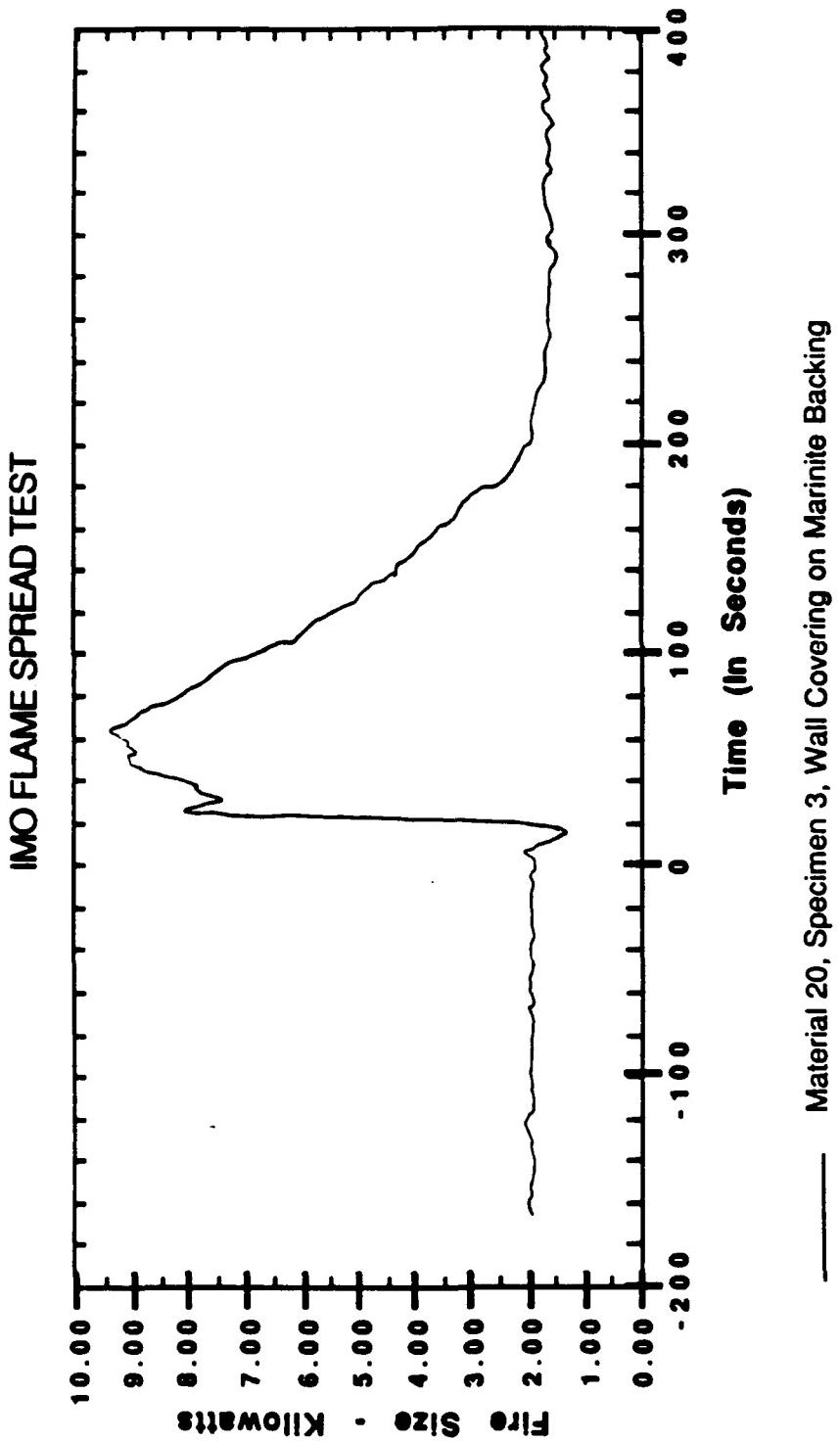


TEST: M20S3SP2 Specimen Number 3  
DATE: 19 October 1987

Material: Wall Covering

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7	50-100	Flashing flames
10	0-300	Spontaneous flames
16	300	Steady flame front
23	350	Steady flame front about 6" height into stack
36	400	Unstable flame front flashing on and off
44	0-300	Steady flames across specimen 6" height
47	300-400	Unstable flaming flashing on and off
55	3.70mv	Pyrometer reading
80 - 85	400	Unstable flame front flashing on and off on center line
93	0-300	Steady flaming
96	300-400	Unstable flaming flashing on and off
102	3.77mv	Pyrometer reading
115	0-150	No flame, extinguished
125	150-350	Flames becoming unstable and decreasing rapidly
133		Still have an unstable flame front flashing on and off
180	3.68mv	Pyrometer reading
185		Still have an unstable flame front flashing on and off
195	300-500	Unstable flaming flashing on and off
220		Flames out, extinguished. Flame spread distance 490mm
233	3.64mv	Pyrometer reading
245	0-250	No material left on specimen
250 - 260	250-490	Black char and cracking across surface and flaking off specimen gradually
270	490	Black char line and flame spread
distance		
275	550	Progression of bubbles
280	3.64mv	Pyrometer reading
505	3.64mv	Pyrometer reading
510	0-250	No material left on specimen
520	250-490	Black char with surface cracking and flaking
528	490-600	Progression of bubbles
537	490	Flame spread distance



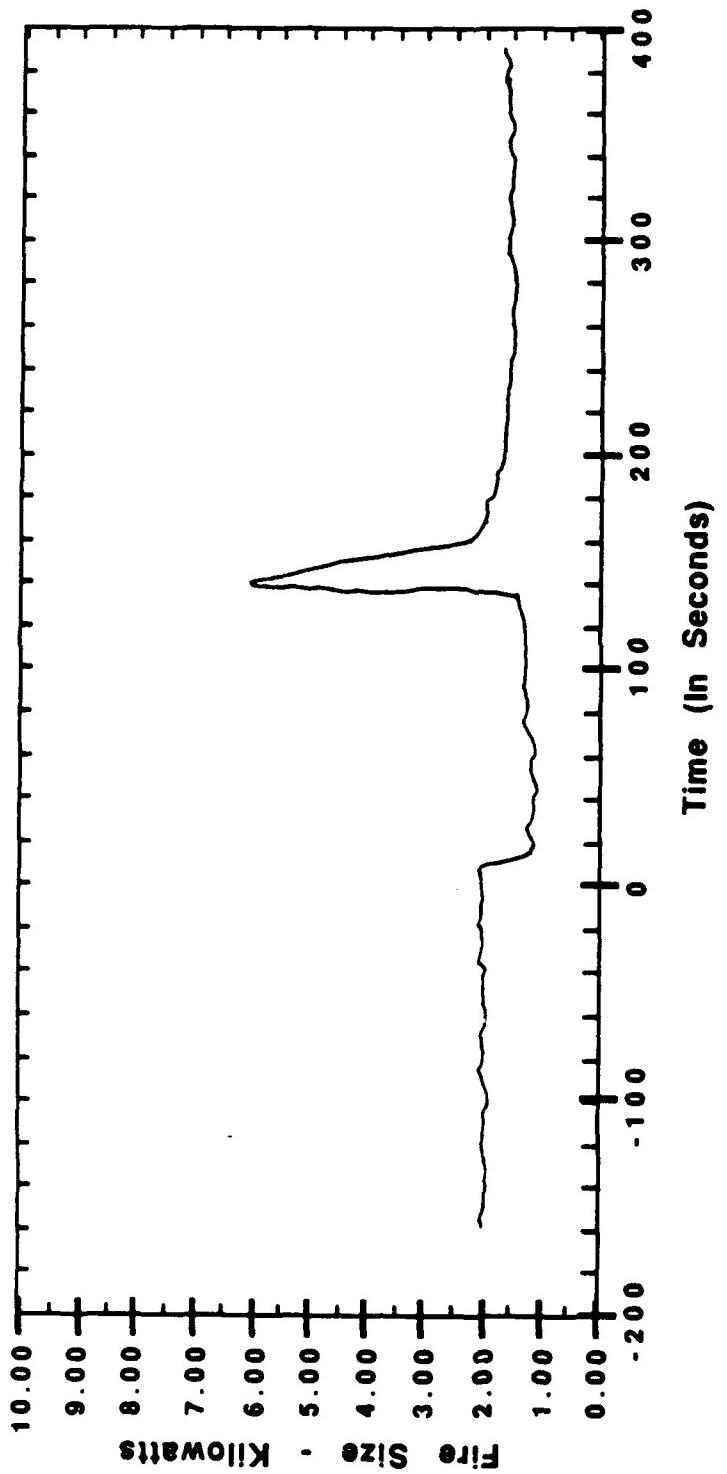
TEST: M21S1SP1 Specimen Number 1  
DATE: 14 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
18		Light smoke starting to form
35		Moderate smoke
52	0 - 200mm	Heavy smoke specimen start to char
57	0-150	Char
72	200	Heavy smoke and char line, No Flames
107	225	Heavy smoke and char line No Flames
115	3.46mv	Pyrometer reading
160	100	Spontaneous flames
161	150	Spontaneous flames
163	200	Spontaneous flames across surface 6" height
173	450	Surface bubbles position
187		Flames are unstable
194		Flames are out extinguished
200	240	Flame spread distance, light smoke
212	250	Dark char line
220	0-150	Material separating and turning to white char
262	3.50mv	Pyrometer reading
437	3.56mv	Pyrometer reading
445	0-200	Material turning white char and separating at the bottom of specimen
460	200-300	Dark black char line
465	300-350	Light black char line
470	350-550	Bubbles across the surface above and below the center line
490	3.58mv	Pyrometer reading, test secured

IMO FLAME SPREAD TEST



Material 21, Specimen 1, Coating on GRC Board Backing

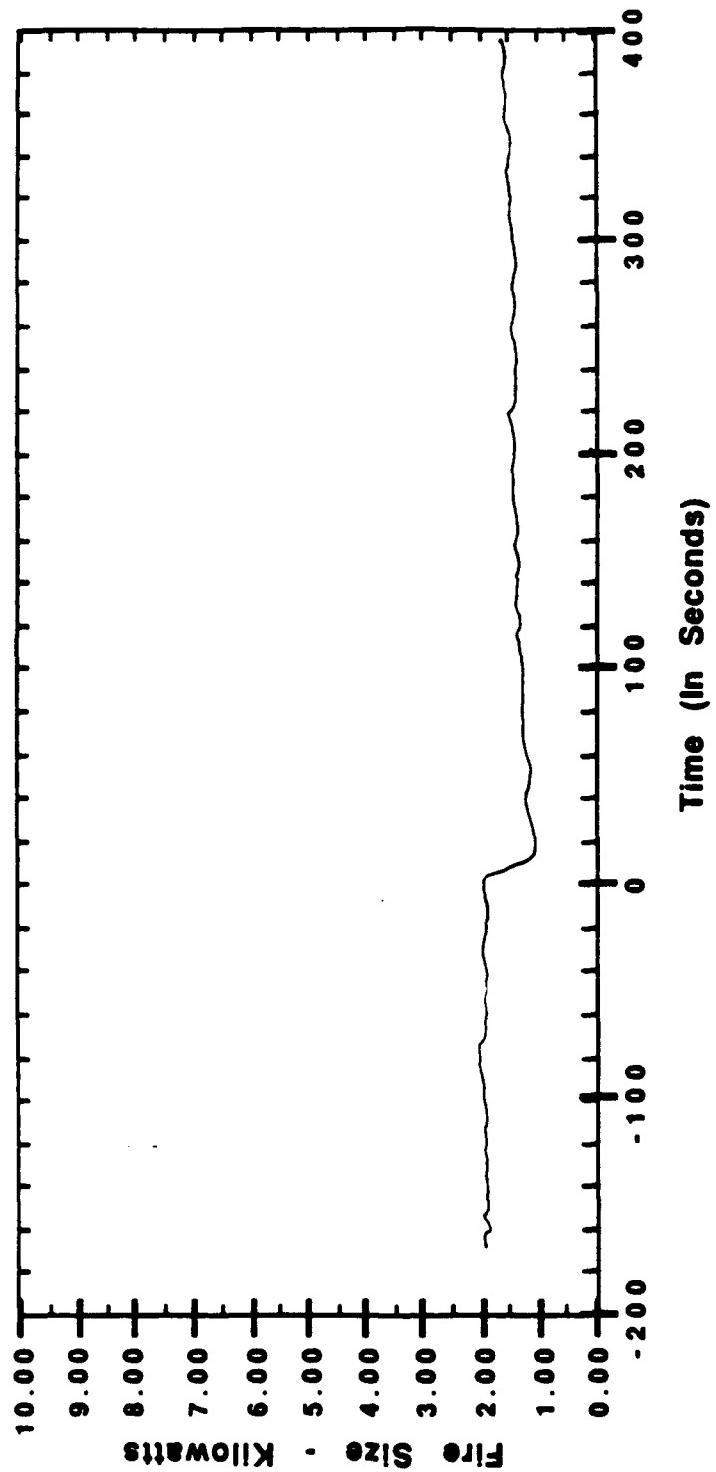
TEST: M21S2SP1 Specimen Number 2  
DATE: 15 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
22	up to 250	Spontaneous bubbles across specimen
25	0-100	Smoke
33	300	Bubbles and light smoke
42	200	Smoke heavy
45	350	Bubble progression
50	0-150	Char and heavy black smoke
55	350	Bubble progression
80 - 90	0-200	Heavy black smoke with black char on the bottom half of specimen slowly progressing upward pass center line
95	400	Bubbles progression
122	3.44mv	Pyrometer reading, moderate smoke
150	250	Moderate smoke and light brown char
161	450	Bubbles progression across specimen
178 - 190	0-150	Black char on lower half of center line with light char surrounding this area
195		No flaming at this time
270	0-250	Complete black char
275	250-300	Light brown char
282 - 287	250-525	Bubbles across specimen above and below center line, moderate smoke
295	0-50	White char on bottom half of center line
300	3.49mv	Pyrometer reading
445	3.53mv	Pyrometer reading still no flaming
495	0-150	White char across specimen
507	150-300	Complete black char
517	300-600	Light brown char
526	300-575	Bubbles and light smoke
537	3.57mv	Pyrometer reading, no flaming

IMO FLAME SPREAD TEST



— Material 21, Specimen 2, Coating on GRC Board Backing

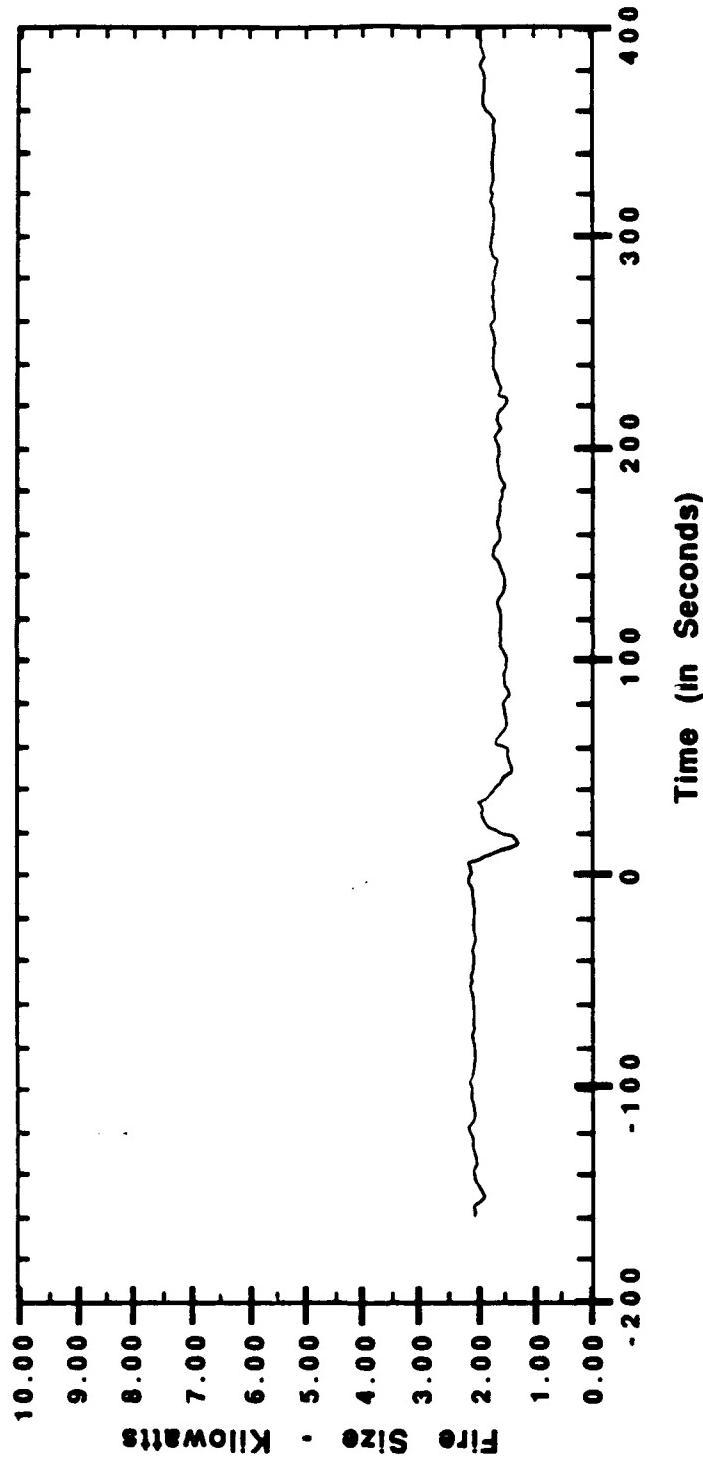
TEST: M21S3SP1 Specimen Number 3  
DATE: 19 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
12	50	Char and flaming at impinging flame
19	50	Flaming about 2" height into stack
27	250, 300	Spontaneous bubbles, small hardly noticeable
38	50	Flames are out, extinguished. Moderate smoke
45	350	Progression of bubbles
70		Unstable flaming, flashing on and off at impinging pilot
78	3.43mv	Pyrometer reading
92	400	Progression of bubbles
97-102	250	Light brown char, moderate to heavy smoke and no flaming
151	450	Progression of bubbles across specimen
162 - 167	250	Brown char line with moderate to heavy smoke
172	3.44mv	Pyrometer reading, some smoke escaping behind stack
252	500	Progression of bubbles
258	250	Dark black char line
261	300	Light black char line, moderate smoke, no flames
266	3.47mv	Pyrometer reading
500	3.56mv	Pyrometer reading
515	0-100	White char across specimen
522	100-300	Black char across specimen
527	300-350	Light black char line
533	350-550	Progress of bubbles
540	3.58mv	Pyrometer reading

IMO FLAME SPREAD TEST

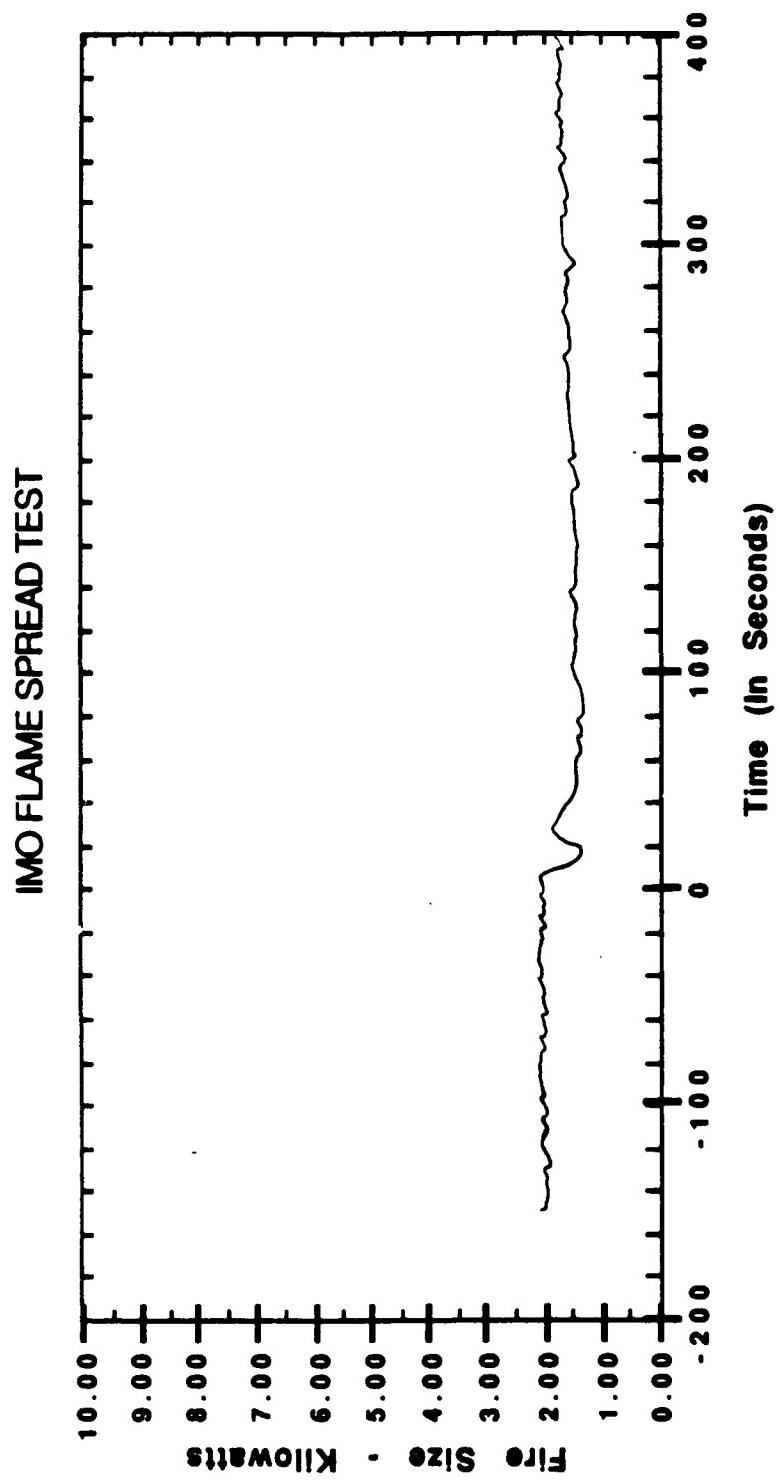


— Material 21, Specimen 3, Coating on GRC Board Backing

TEST: M21S4SP1 Specimen Number 4  
DATE: 23 October 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8		Black char and flames at impinging flames
20	200	Bubbles - 250mm
30	300	Progression of light surface bubbles
36		Moderate smoke
55	350	Progression of bubbles
90	400	Progression of bubbles
95	3.43mv	Pyrometer reading still no flaming
110	200	Heavy smoke with light brown char
120		Some of the smoke is escaping out of stack hood
162	450	Progression of bubbles, moderate smoke
170	250	Light brown char
174	3.45mv	Pyrometer reading, still no flaming
300	0 - 250	Black char across specimen
305	250 - 300	Light brown char
308	300 - 500	Progression of bubbles
312	3.50mv	Pyrometer reading, still no flaming
436	3.55mv	Pyrometer reading, light smoke, no flaming
444	0 - 100	White char along center line
453	100 - 300	Black char across specimen
456	300 - 350	Light brown char
462	350 - 550	Progression of bubbles, still no flaming
555	3.60mv	Pyrometer reading
563	0 - 150	White char across specimen
568	150 - 325	Black char line
576	325 - 375	Brown char line
582	375 - 550	Progression of bubbles



Material 21, Specimen 4, Coating on GRC Board Backing

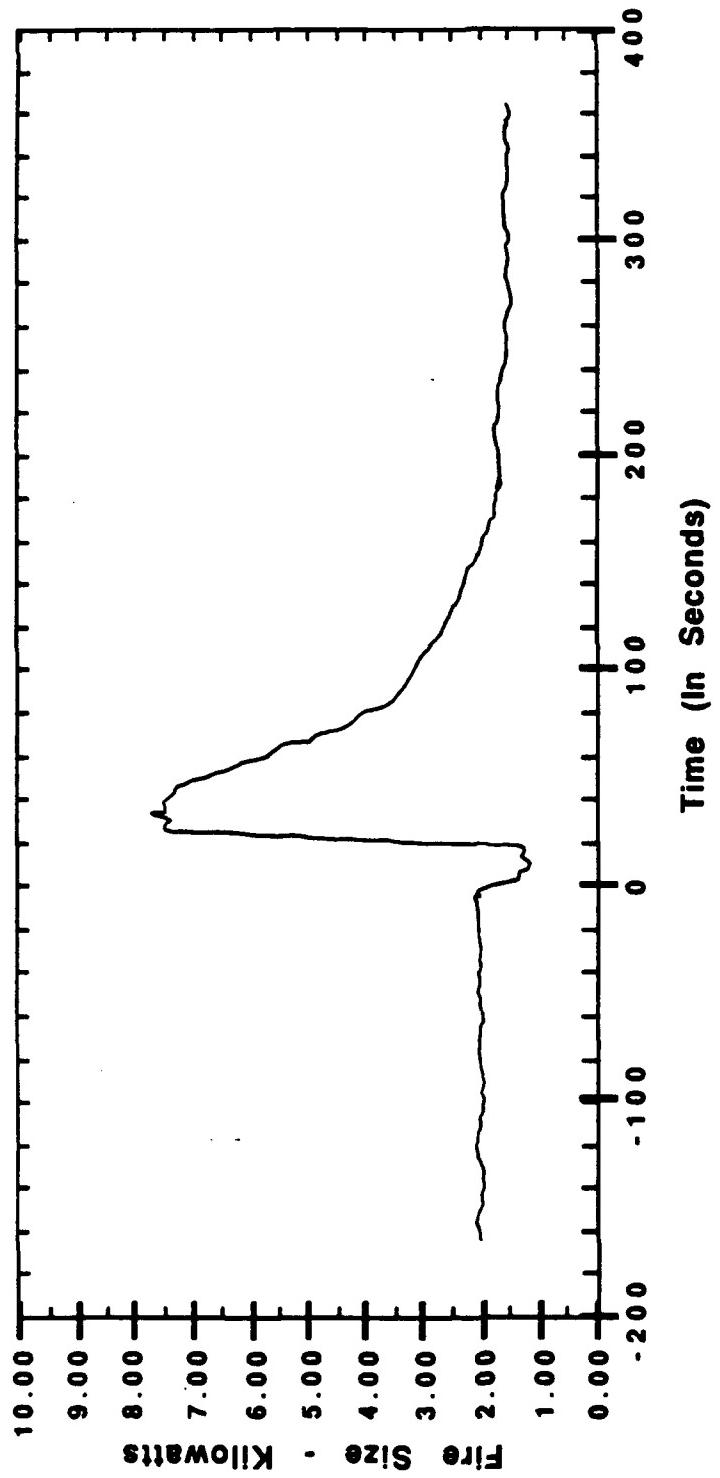
TEST: M21S1SP2 Specimen Number 1  
DATE: 14 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
10	250, 300	Spontaneous bubbles
15	200	Spontaneous unstable flame front
22	250	Flame front
30	300	Flame front with flames 6" into stack
35	400	Bubbles across face of specimen
45	350	Flame front stable
57	0-200	No Flames
65	200-350	Stable flame front
80	400	Stable Flame front
85	0-300	No Flames
90	300-400	Stable flame 4" height
95	500	Bubble across specimen above 4 below center line
100		Flames are decreasing
110		Flames are only 50mm in width
120		Flames becoming unstable
125	3.65mv	Pyrometer reading
175 - 190	450	Unstable flame front
	450	Unstable flame front just crossed center line. This is flame spread distance
197	480	Unstable flaming above center line
203		Flaming out, extinguished
210	3.62mv	Pyrometer reading
227	0-350	Material white char and separating from specimen backing
235	350-450	Black char line also flame spread distance
250	475	Flame spread distance above center line
255	550	Bubbles across specimen above and below center line, light smoke
402	0-150	Material white char and separating from backing
417	150-350	All material has fallen off specimen
425	350-450	Dark black char line
430	450-475	Light black char line
435	560	Bubbles across specimen above 4 below center line
445	3.63mv	Final pyrometer reading
450		Test secured

IMO FLAME SPREAD TEST



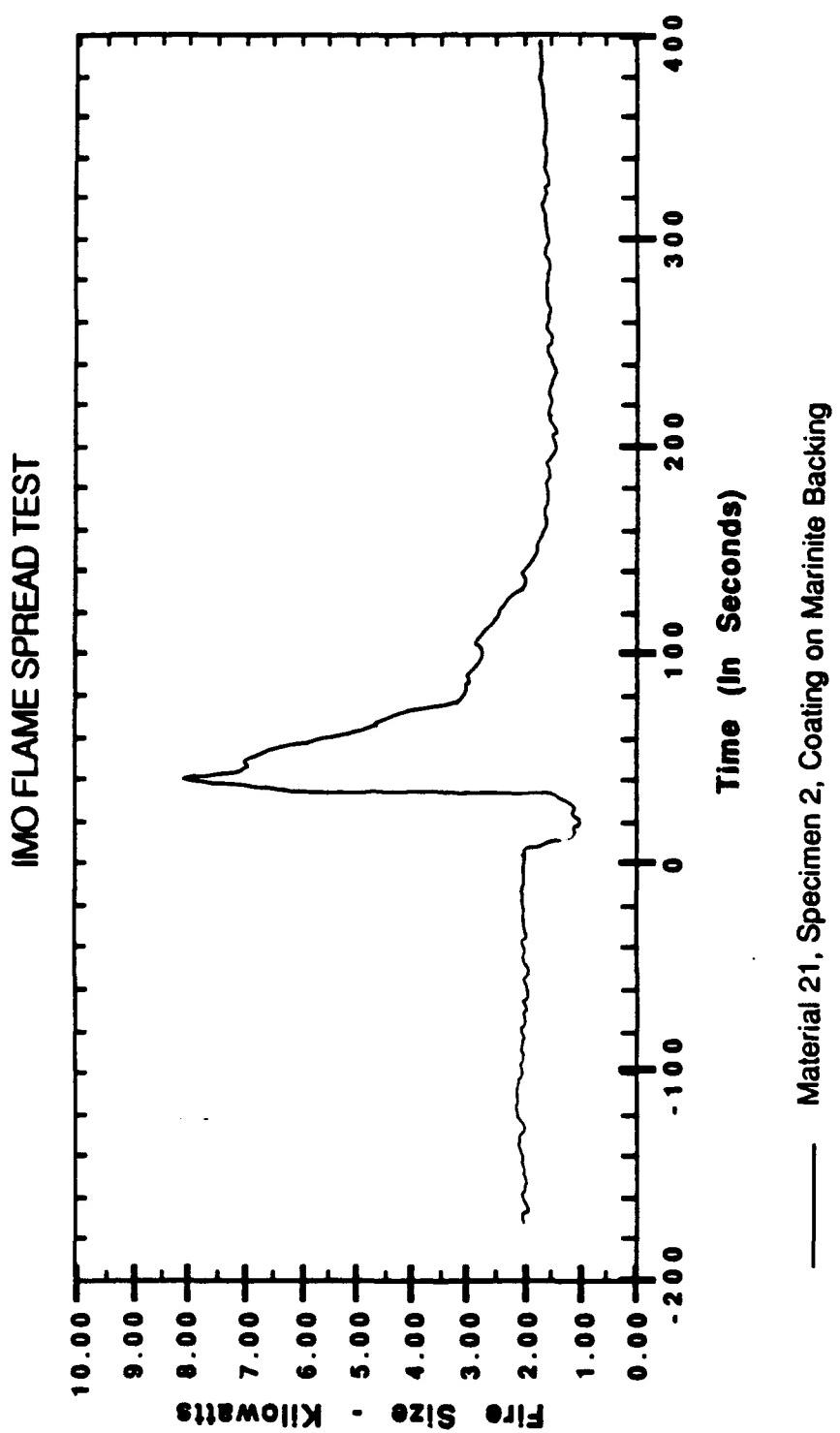
Material 21, Specimen 1, Coating on Marinite Backing

TEST: M21S2SP2 Specimen Number 2  
DATE: 16 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	250-300	Spontaneous bubbling and smoking
13	150-200	Moderate smoking to heavy
17	0-200	Black char on top of bubbles surface
22	400	Bubbles across surface
23	0-250	Spontaneous flaming
25	300	Stable flaming about 6" height into stack
38	350	Stable flame front
44	3.60mv	Pyrometer reading
53	460	Bubbles across surface
57	0-200	Flaming has decreased
62 - 70	200-375	Steady but unstable flaming decreasing rapidly from 0-300mm
75 - 80		Steady flame width is about 50mm wide decreasing to an unstable flame
83	400	Flaming crossed center line
130	450	Stable flame front on center line 3" height
138	3.61mv	Pyrometer reading
153 - 158	0-350	Material has turned white char and separating from back of specimen and starting to flake off.
162	350-450	Black char
164	460	Flame is out extinguished at center line
175	3.9mv	Pyrometer reading
186 - 195	350-450	Specimen is black char turning to white char and separating from backing on top of specimen
207	625	Progression of bubbles
520 - 527	0-350	Material has separated and fallen off leaving an exposed backing on sample
530 - 538	350-450	Black char on specimen and separated on top on specimen sample, can fall any time
545	460	Flame spread distance
550	450-500	Light brown char line
555	500-625	Progression of bubbles
562	3.60mv	Final Pyrometer Reading



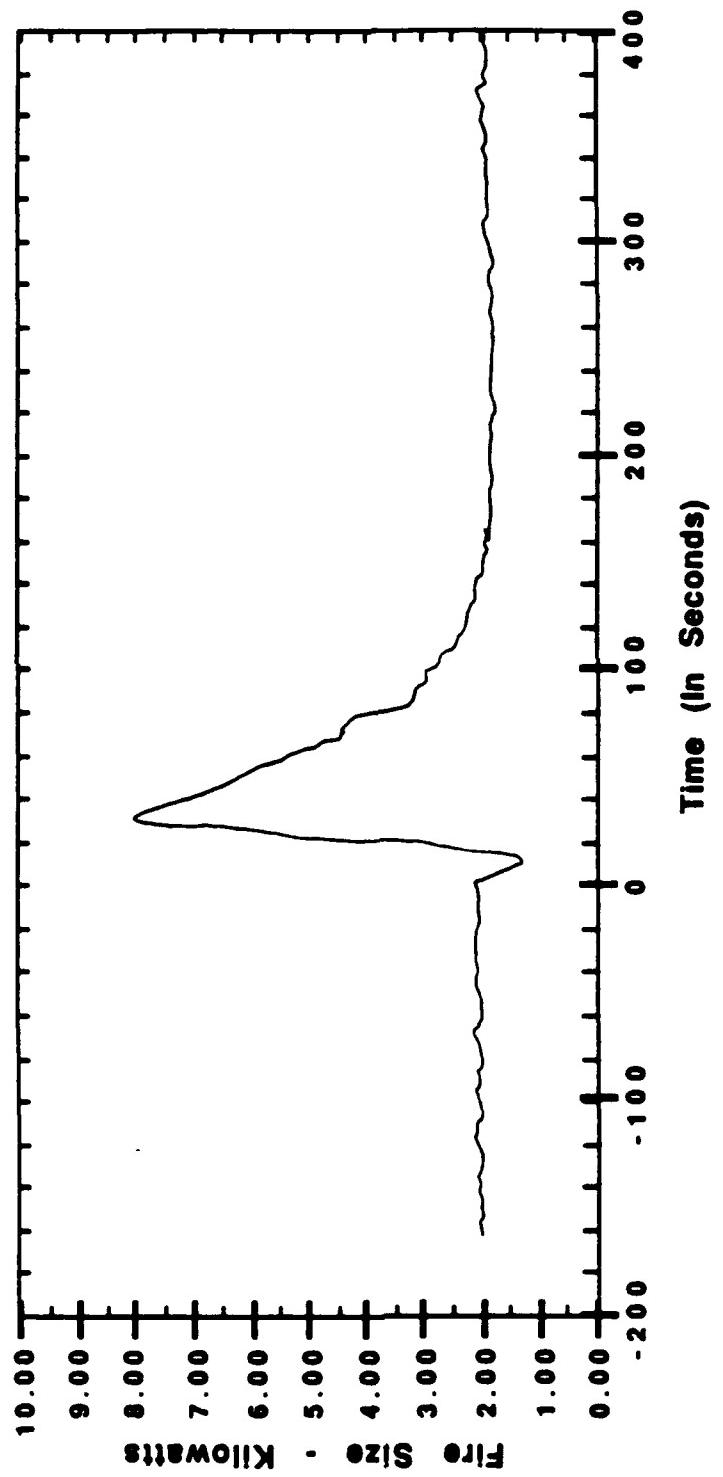
TEST: M21S3SP2 Specimen Number 3  
DATE: 19 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	0 - 200	Spontaneous bubbles
11	50, 100	Flaming
14	150	Flashing flames
17	200	Flame front flashing
22	250	Flame front steady
25	300	Flame front steady
31		Flaming about 6" height into stack
35	425	Progression of bubbles
45	350	Flame front steady
50	0-150	No flames
54	150-350	Steady flames and flame front
56		Decreasing flames to 4" height into stack
74	400	Stable and steady flame front
78	3.63mv	Pyrometer reading
88	0-350	No flames
97	350-400	Stable flaming 2" height into stack
135		Flame front is out, extinguished. Flame spread distance 425mm
145	525	Progression of bubbles
150	3.61mv	Pyrometer reading
480	3.61mv	Pyrometer reading
485 - 492	0-400	Material separating from backing and flaking with surface cracks and white with char
495	400-425	Black char distance
502	425-550	Bubbles on top and bottom of center line
510	425-525	Light brown char on top of bubbles
525	3.62mv	Pyrometer reading

**IMO FLAME SPREAD TEST**



Material 21, Specimen 3, Coating on Marinite Backing

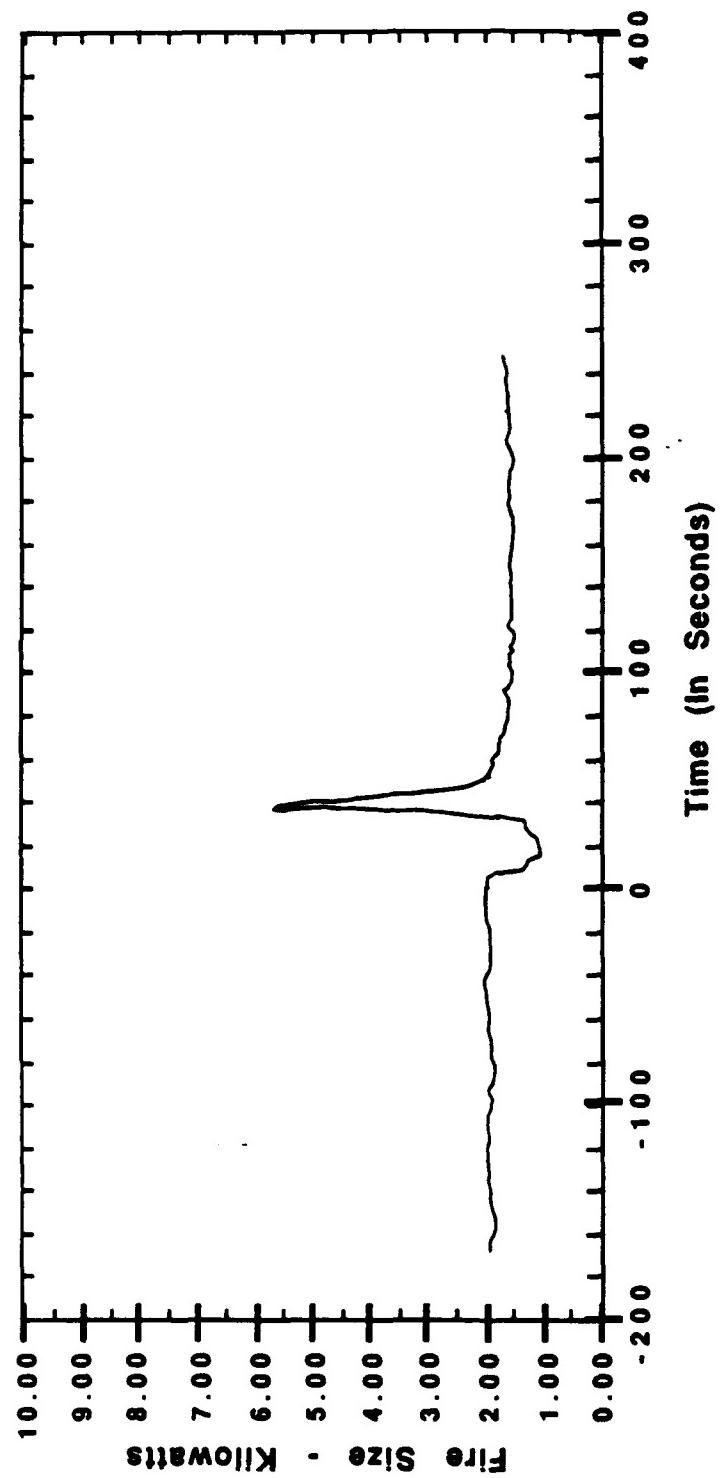
TEST: M22S1SP2 Specimen Number 1  
DATE: 14 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7	0 - 350, 0 - 400	Spontaneous bubbles
11	0 - 250	Moderate to heavy smoke
17	300	Black char on top of bubbles
22	450	Bubbles and heavy black smoke
25		Flames on top of specimen holder
27	0 - 250	Flames across the specimen
32 - 37	300	Unstable flame front material falling off specimen as flames progress across sample
43		Flames are out extinguished
47	300	Flame spread distance
48 - 58		Summary: As flames progressed material fell off specimen backing but still attached up to 300mm falling across specimen causing flames to go out, smothering.
60	500	Bubbles across specimen above and below center line, moderate smoke
68	3.53mv	Pyrometer reading
245	0-225	No material is left on specimen
250 - 260	225-300	Material has separated from backing and laying off over existing material, but has not fallen off specimen, still is attached to specimen
270	300	Flame spread distance
280	300-450	Brown char line with material separating but still attached to backing, surface cracks
285	550	Bubbles across specimen above and below center line
290	3.60mv	Pyrometer reading

IMO FLAME SPREAD TEST



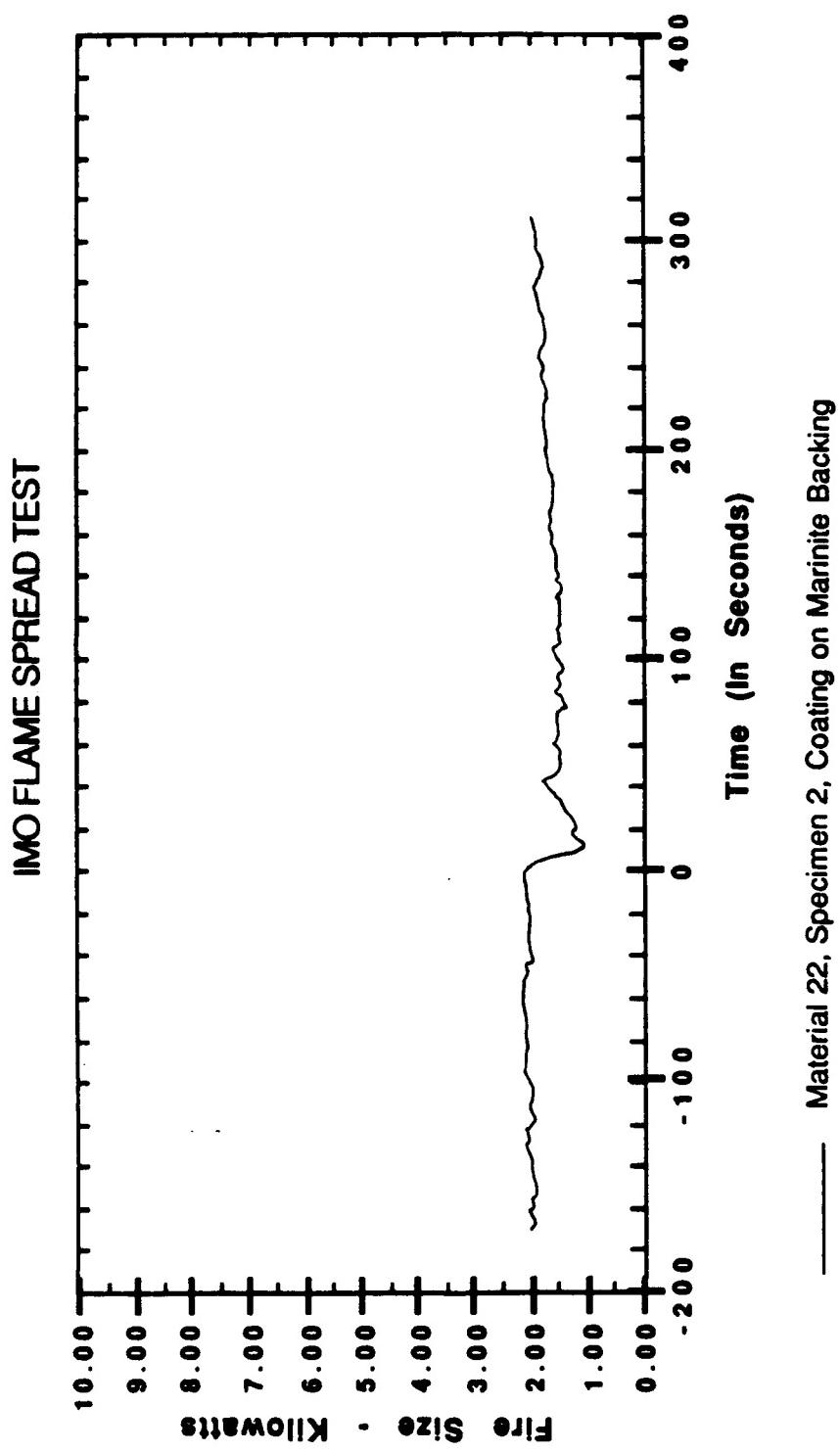
Material 22, Specimen 1, Coating on Marinite Backing

TEST: M22S2SP2 Specimen Number 2  
DATE: 16 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
8	200, 250, 300	Spontaneous bubbles
12		Black char on top of bubbles surface
15	250	Heavy smoke
20	300	Black char on top of bubbles surface
25 - 26	0-250	Charring across specimen, moderate smoke material is starting to separate from specimen backing with moderate smoke
40		Heavy smoke now, no flaming
105	3.54mv	Pyrometer reading
115 - 122	0-300	Material has separated from backing and fallen off of specimen, this material did not burn
125	300-400	Light brown char across specimen
130	400-500	Progression of bubbles, light smoke
341	3.56mv	Final pyrometer reading
347	0-250mv	No material left on specimen
355	250-350	Material is separating but still attached
364		Can fall off any time
368	350-450	Material starting to crack and separate
372	400	Dark brown char line
377	475	Light brown char line
382	525	Bubbles across specimen
387	3.55mv	Pyrometer reading

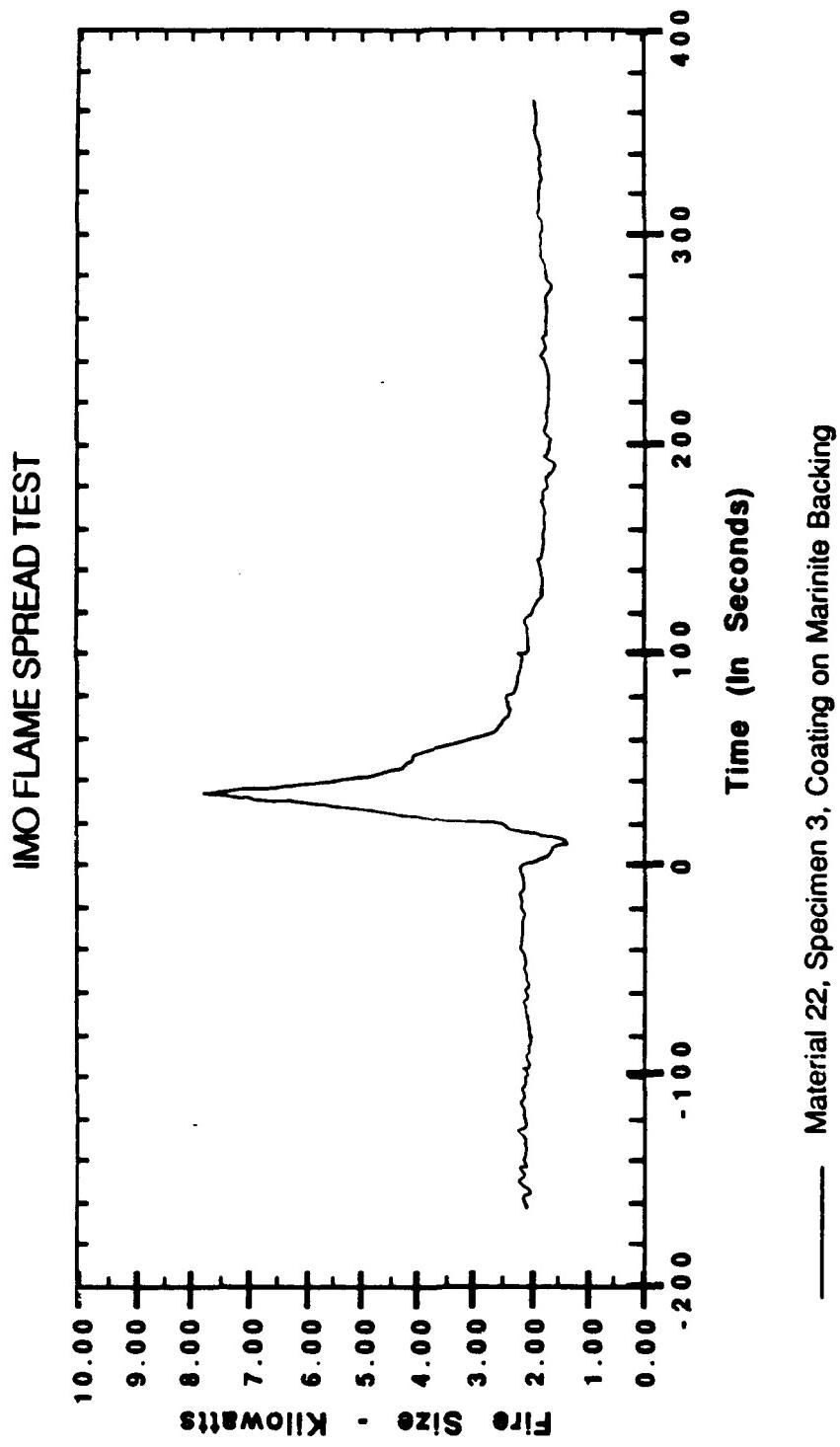


TEST: M22S3SP2 Specimen Number 3  
DATE: 19 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
7	200	Bubbles
8	50	Flame
15		Bubbles at 300mm, flaming flashing across specimen 150mm, 200mm
24	200	Flaming becoming more stable now
30	300	Flashing flames become unstable with material falling off specimen as fast as flame progresses across specimen
40	300	Flame spread distance stable, but ahead of flame front is unstable flaming
48	500	Progression of bubbles
56		Flame height about 4" in height, flame width is about 50mm wide, unstable, flashing on and off
65		Flames are out, extinguished
70	3.59mv	Pyrometer reading
75	340	Flame spread distance
340		Material fell off specimen in the path of the pyrometer, resulting in a 2.70mv pyrometer reading
375		Material just fell, pyrometer reading 3.62mv
390-398	340	Flame spread distance, again cannot see flame spread distance on specimen because material fell off, burnt off from exposure to heat after flame extinguished
400	0-400	No material left on specimen. Material fell off as flames progressed
415	400-440	Light black char with material above and below center line. No material is on the center line
433	440-475	Light brown char across specimen
442	525	Bubbles across specimen
447	3.62mv	Pyrometer reading

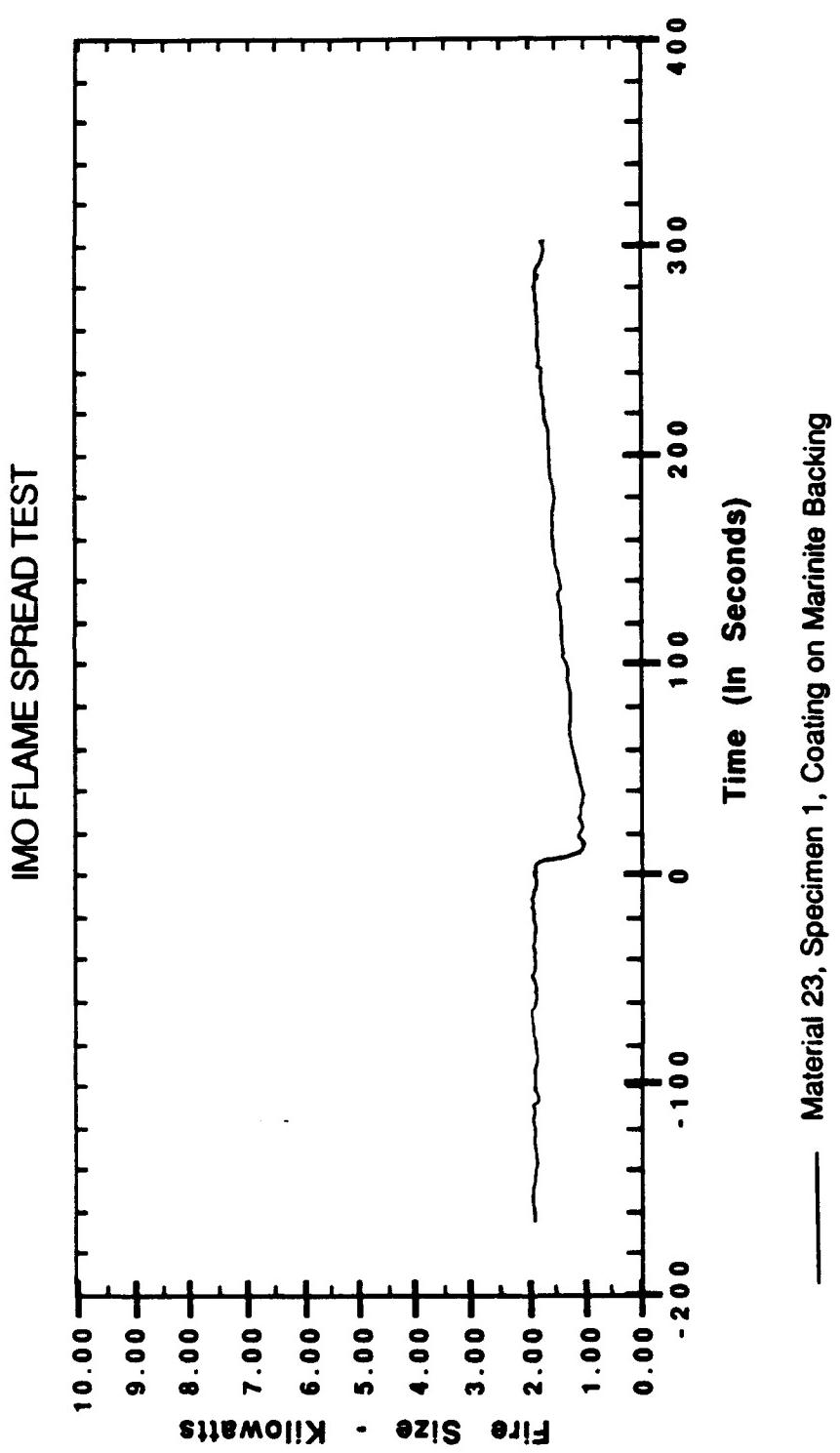


TEST: M23S1SP2 Specimen Number 1  
DATE: 14 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
20	50	Light smoke and light char forming
30	100	Light smoke and char
37	50	Smoke turn heavy and dark char forming
46	200	Smoke and light char forming and bubbles
55	100	Heavy smoke and dark char, bubbles
64	200	Bubbles across specimen above and below center line
85	250	Heavy black smoke
90	200	Black char line
95	300	Light brown char line
100	3.47mv	Pyrometer reading
105	100	Material separating with vertical crack across specimen
130	350	Heavy black smoke and bubbles, light brown char
140	0-100	Material has separated from backing and turning white char
180		Note: Heavy black smoke is too much for stack to handle, smoke escaping behind thermocouple stack
195	350	Material has separated from netting back, heavy smoke, still no flaming
220	3.59mv	Pyrometer reading
235	350	Still moderate to heavy smoke with some escaping behind stack
260	0-100	White char
265	200-350	Black char
270	0-350	Material has separated from netting back but did not fall yet
285	400	Light brown char line
290	3.63mv	Pyrometer reading
315		Smoke has decreased to moderate rate
375 - 390	100-350	Material has fallen off, leaving netting back exposed. Still moderate smoke
550	3.66mv	Pyrometer reading
555	0-100	Material white char, still attached to back
565	100-350	Material has fallen off, leaving netting exposed
575	350-450	Black char with material separating at 450mm position causing vertical crack
590		Light smoke and no flames on this test



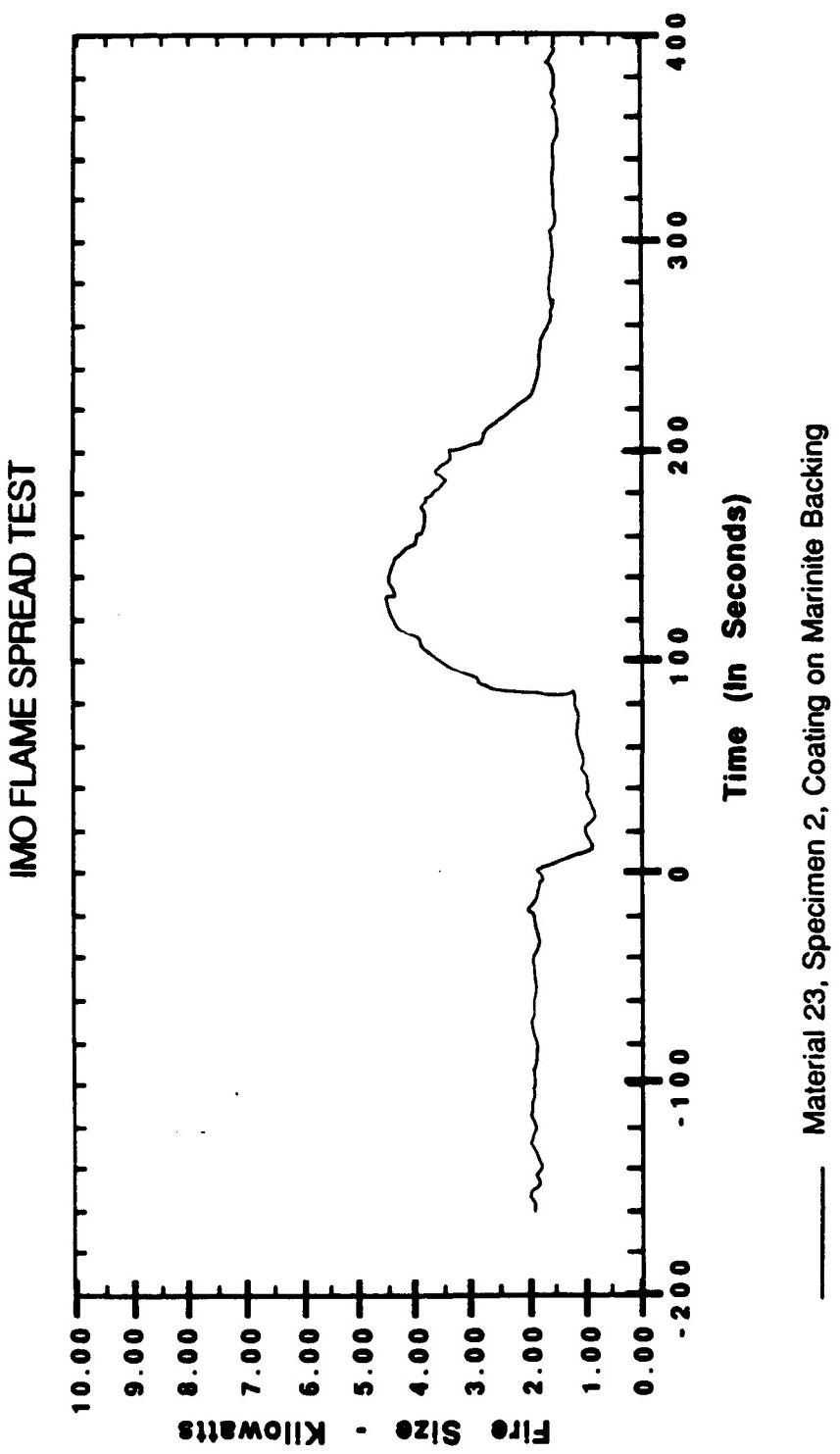
Material 23, Specimen 1, Coating on Marinite Backing

TEST: M23S2SP2 Specimen Number 2  
DATE: 16 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
28	0-150	Light smoke forming
34	0-150	Moderate smoke forming
40	0-150	Light char forming across specimen
55	0-300	Bubble progression
60 - 65	300	Light char progression, smoke turning heavy at this time, no flaming
70	0-200	Black char across specimen
75	3.46mv	Pyrometer reading, no flaming
100 - 110		Light flames on top of specimen holder, not on the specimens about 2" into stack
120	150	Specimen has a vertical crack across face of sample, with specimen starting to separate on top of sample
135	250	Vertical crack forming across face
140		Flames on top of specimen holder increasing to about 6" into stack, moderate smoke
160		Specimen is not burning, flames are on top of specimen holder
165		Pyrometer reading
185	0-100	No flames on top of specimen holder
197	100-300	Light flame on top of specimen holder
275	0-300	All flames are out on top of specimen holder
283	3.64mv	Pyrometer reading, light smoke
295	150, 300	Vertical crack across face of specimen
300 - 310		Material is separating along the edges of the specimen but still attached
320	0-300	White char across specimen
325	300-400	Black char across specimen
415	3.66mv	Smoke has decreased to a minimum, pyrometer reading
440		No flaming on specimen
465	425	Vertical crack forming
470	300-425	Black char
870 - 890	0-350	Material completely white with char, with vertical crack across face at 150, 300 and 450mm. Material has separated along the edges of specimen but still attached to backing
895	350-475	Complete black char
905	475-500	Light brown char
910	3.66mv	Final pyrometer reading



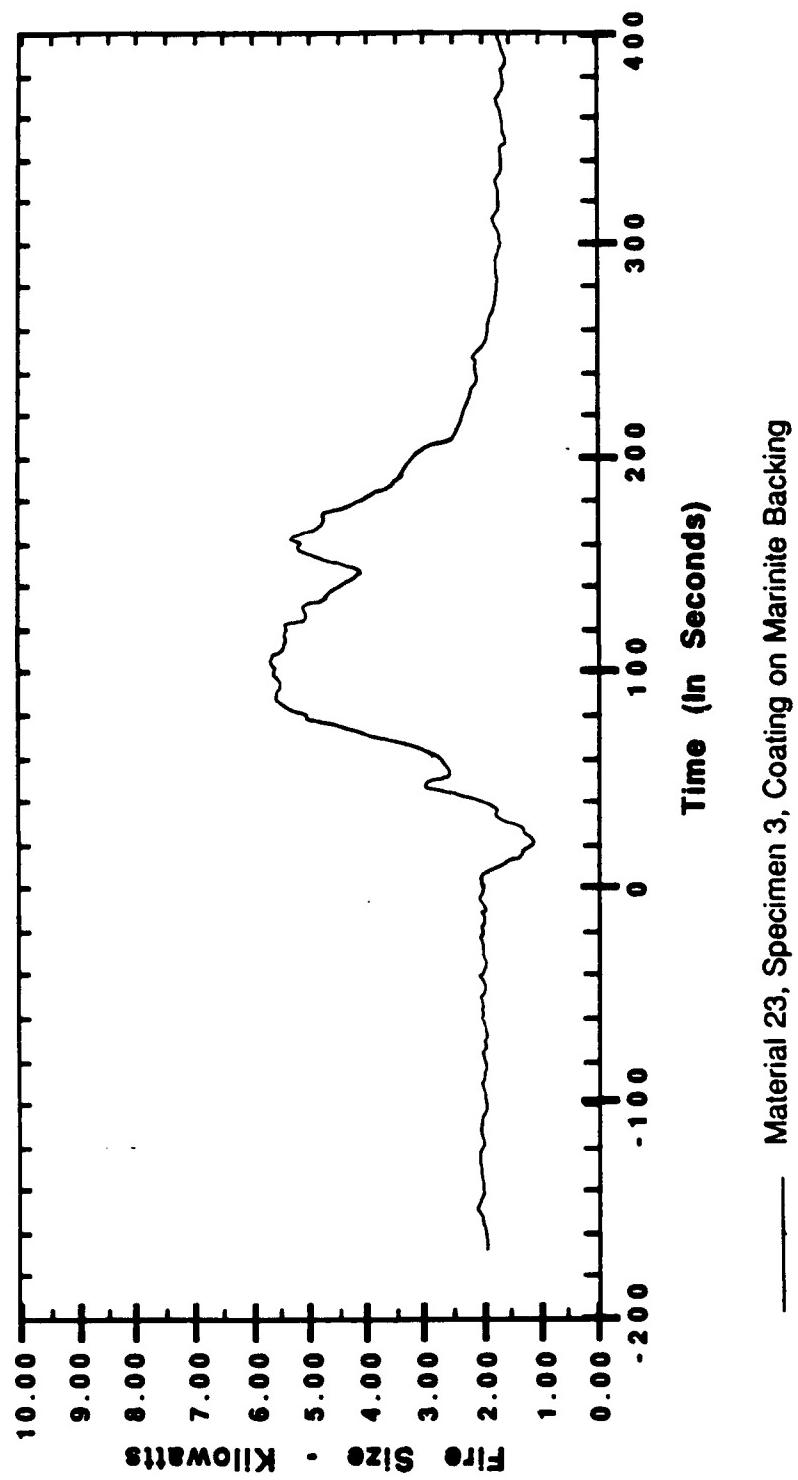
TEST: M23S3SP2 Specimen Number 3  
DATE: 19 October 1987

Material: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
25		Char and light flaming at impinging flame with moderate smoke
32	0-150	Flames flashing on and off across specimen
38	200	Flashing flames on and off
45	250	Dark brown char and heavy smoke
50		Flashing flames are out, extinguished
60		Flashing flames across top of specimen holder
68		Flashing flames across specimen
75	100	Unstable flaming above center line, flashing
83	100-250	Unstable flashing flame on and off
85 - 90	250	Vertical crack across specimen face and is separating from backing
95	100	Flaming becoming stable
100	100-250	Flashing flames on and off unstable
115	3.56mv	Pyrometer reading
130		Still have unstable flame front flashing on and off
158	0-250	Material has separated and starting to fall
170 - 177		Flaming is from the glue on specimen backing, from the specimen that had just fallen
190	0-100	Steady flaming on specimen backing which is a mesh netting
205	0-300	Unstable flashing flames across top of specimen holder
220	200	Unstable flaming flashing across specimen backing which is a mesh netting
232	3.59mv	Pyrometer reading
240 - 250		Flame is skipping around specimen flashing on and off, height of flame about 2"
255	0-200	Flames are out, extinguished
310 - 335		All flames are out when piece of material fell at 250mm mark, the glue on specimen backing burning, unstable and flashing, another vertical crack at 380mm
342	3.62mv	Pyrometer reading
530	3.62mv	
540 - 545	0-250	No material left on specimen leaving an exposed mesh backing

IMO FLAME SPREAD TEST



— Material 23, Specimen 3, Coating on Marinite Backing

TEST: M23S4SP2 Specimen Number 4  
DATE: 23 October 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
13		Flaming and charring at impinging flame
21	150	Bubbles on center line
35	150	Unstable flaming on and off flashing, smoke
42 - 50		Smoke is escaping from behind the specimen. Flashing flames are out extinguished, gases
65	250	Heavy smoke and black char, flame is blue and skipping across surface
75	50	Unstable flaming flashing across the surface up to 300mm flashing on and off, skipping
92	150	Unstable flaming and vertical crack across test specimen
100	150 - 300	Flashing flames skipping across surface
110	150	Stable flaming about 4" height into stack
123	150 - 300	Flashing flames on and off, skipping
138	200	Unstable flame front
148	250	Unstable flame front, 2" height into stack
175	325	Unstable flame front, flashing on and off with a vertical crack across specimen
195		No more flashing flames in front of flame front
205	325	Flame front
210	3.66mv	Pyrometer reading
220		Flame front is flashing on and off
225 - 232		Flame is out, extinguished on test specimen, you do have light flames on specimen holder
237		Flames are out on the specimen holder
245	325	Flame spread distance
250	150 & 325	Vertical cracks across specimen with 325mm being the flame spread distance
547	3.67mv	Pyrometer reading
557 - 570	0 - 325	Material white with char with vertical crack across specimen at 150 + 325mm with 325mm being the flame spread distance

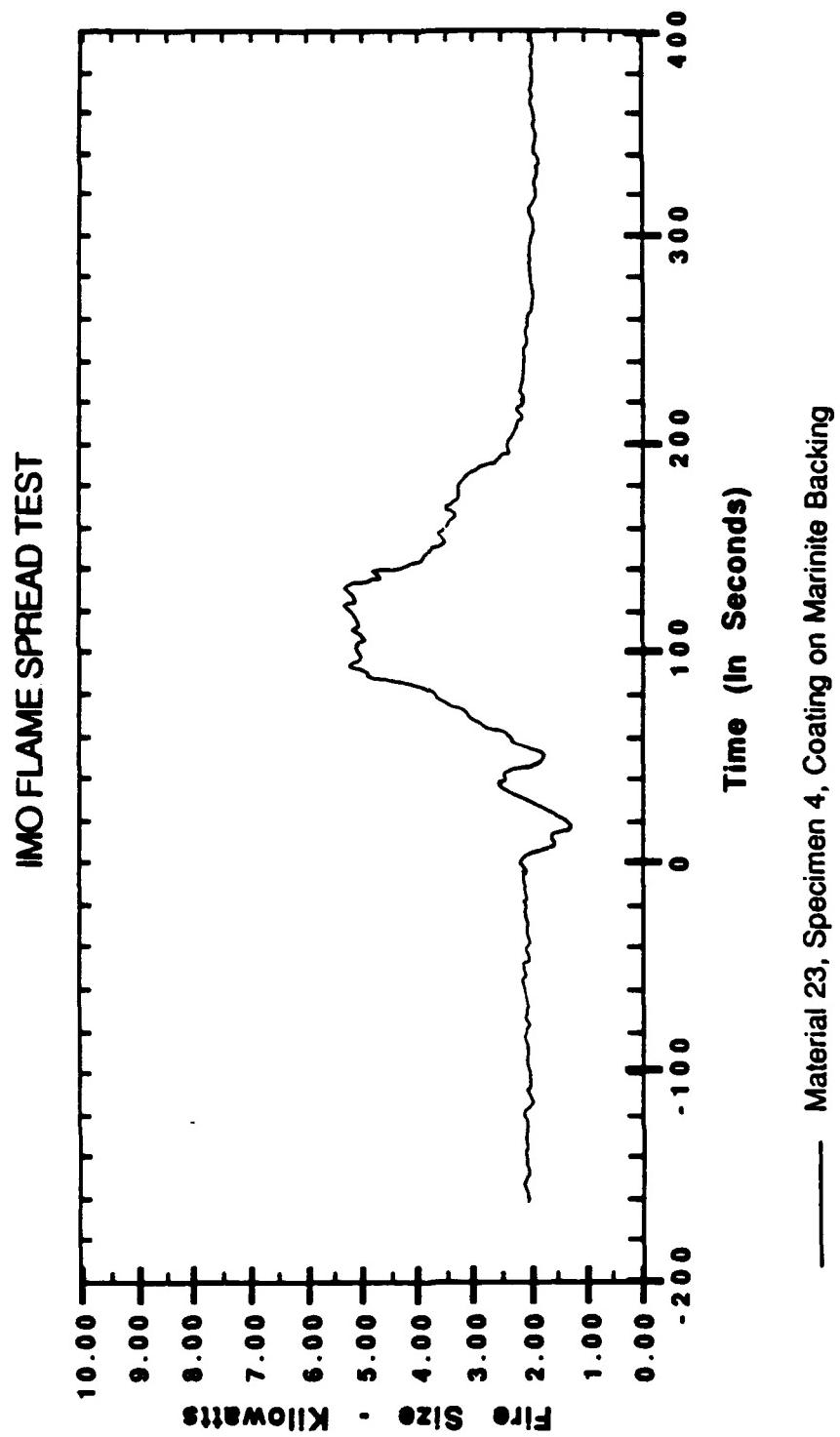
TEST: M23S4SP2 Specimen Number 4 (cont'd)

DATE: 23 October 1987

MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
575	150	Material has separated from backing
585	325 - 425	Black char with vertical crack at 425mm
598	425 - 475	Light brown char
610	3.66mv	Pyrometer reading

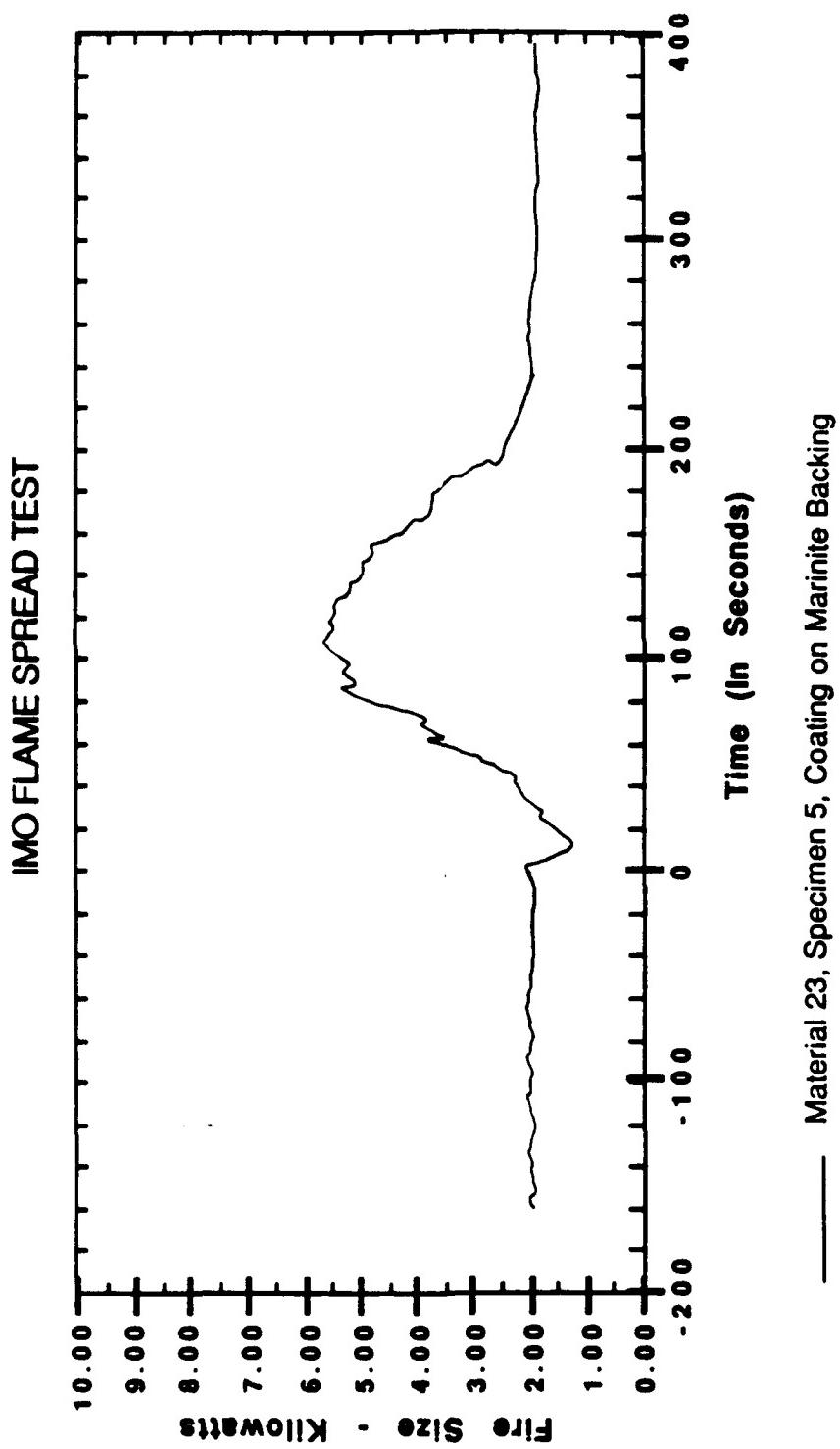


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TEST: M23S5SP2 Specimen Number 5  
DATE: 24 October 1987  
MATERIAL: Coating

USCG - IMO SURFACE FLAMMABILITY TEST

Time (sec)	Distance (mm)	Remarks
13		Black char and smoke at impinging flame
23		Unstable at impinging flame
33	50	Unstable flaming flashing on and off
44	150	Brown char and moderate to heavy smoke
48	150	Flashing flames
55	0-200-250	Flames are skipping across specimen
60 - 72	250	Complete black char and heavy smoke, flashing flames are skipping across specimen blue in color
80 - 95	50	Steady flame about 4" height into stack ahead of flame flashing flames skipping across the surface up to 300mm
111	100	Steady flame front
130	150	Unstable flame front turning steady
145	200	Stable flame front, ahead of front flame is skipping across surface up to 350mm
162	0 - 150	Unstable flaming
165	150 - 200	Stable flame front
188	250	Stable flame front becoming unstable
213 - 225	250	Vertical surface crack with air coming from behind specimen - making flame unstable
228	3.65mv	Pyrometer reading
232		Flames are flashing on and off
244		Flames are out, extinguished
250	250	Flame spread distance
254	3.64mv	Pyrometer reading
530	3.65mv	Pyrometer reading
536	0 - 300	White char
542	300 - 450	Black char
550	100, 250, 300, 400	Vertical cracks across specimens and starting to separate from backing



**APPENDIX C**  
**ASTM E-84 TEST DATA**

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This appendix presents the results of flame spread tunnel tests on a random sampling of ten interior finish materials approved by the U.S. Coast Guard. The tests were conducted in accordance with the provisions of ASTM Designation E84-84, "Standard Method of Test for Surface Burning Characteristics of Building Materials" at Southwest Research Institute, San Antonio, Texas.

The purpose of the test was to evaluate performance of the test specimen in relation to that of glass-reinforced-cement board and red oak flooring under similar fire exposure. The results are expressed in terms of flame spread, fuel contribution, and smoke developed during a 10-minute exposure and are recorded as a ratio with glass-reinforced-cement board 0 and red oak flooring 100.

Prior to testing, the specimens were conditioned in an atmosphere maintained between 68°F and 78°F (20°C and 26°C) temperature and 45-55 percent relative humidity. Reference data were obtained and furnace operation checked by conducting a 10-minute test with glass-reinforced-cement board on the day of the test and by periodic tests with red oak flooring. These tests provided the 0 and 100 references for flame spread, fuel contribution, and smoke developed. Ignition over the burners was noted 37 seconds after the start of the test in the most recent calibration with red oak flooring.

The test results were calculated on the basis of observed flame travel and the measurement of areas under curves of furnace temperature and smoke developed. To allow for possible variations in results due to limitations of the test method, the numerical results were adjusted to the nearest figure divisible by 5.

Tests for materials one through ten were made using glass reinforced cement board as a substrate. Tests for materials 15 through 23 were made using Marinite I or a substrate.

**MATERIAL (1)****DESCRIPTION**

**Material:** M1, Composite Laminate  
**Identification:** 164.012/4/0  
**Cure Time:** 12 days  
**Date of Test:** 12 November 1986

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
Laminated Plastic	10	0	15

**OBSERVATIONS**

Event	Min:Sec	Damage	m (ft)
Steady Ignition	0:50	Consumed	1.53 (5.0)
Blisters	0:58		
Peeling	1:09	Blisters	2.14 (7.0)
Pieces Falling	1:48		
Max. Flame Advance 2.44 m (8 ft)	1:45	Peeling	1.98 (6.5)
		Face Char	2.44 (8.0)
Afterflame	None	Discoloration	7.63 (25.0)

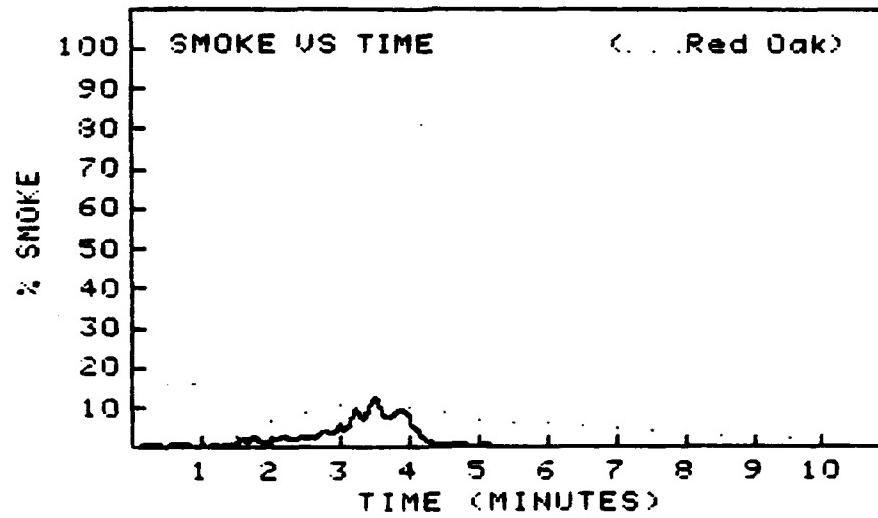
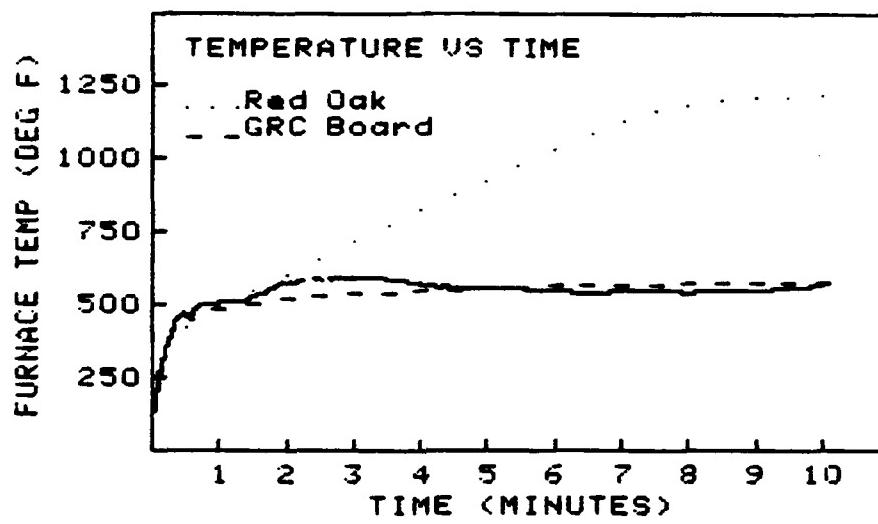
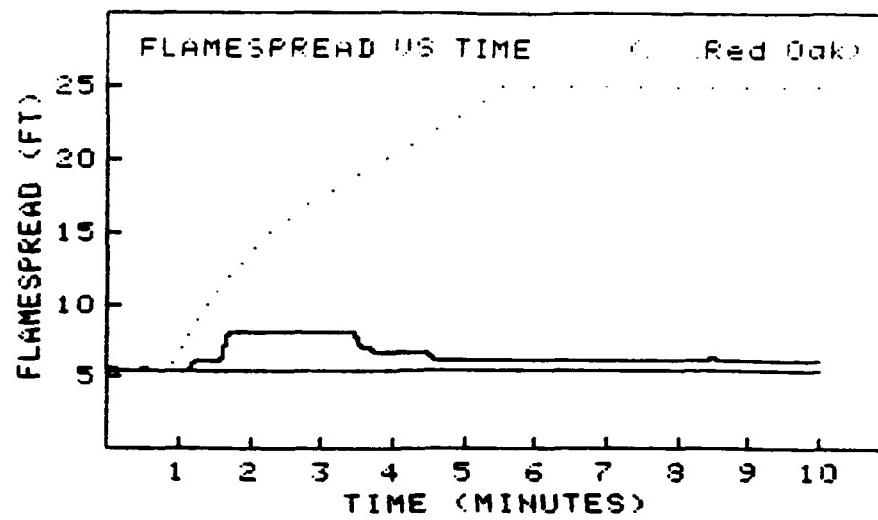


FIGURE C-1 - MATERIAL (1)

**MATERIAL (2)****DESCRIPTION**

**Material:** M2 Composite Laminate  
**Identification:** 164.012/30/0  
**Cure Time:** 12 days  
**Date of Test:** 12 November 1986

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
Melamine Laminate	20	5	5

**OBSERVATIONS**

Event	Min:Sec	Damage	m (ft)
Steady Ignition	0:38	Consumed	1.53 (5.0)
Blisters	0:39		
Peeling	0:50	Blisters	2.44 (8.0)
Pieces Falling	1:03		
Max. Flame Advance 3.51 m (11.5 ft)	3:30	Peeling	2.14 (7.0)
		Face Char	2.59 (8.5)
Afterflame	None	Discoloration	7.63 (25.0)

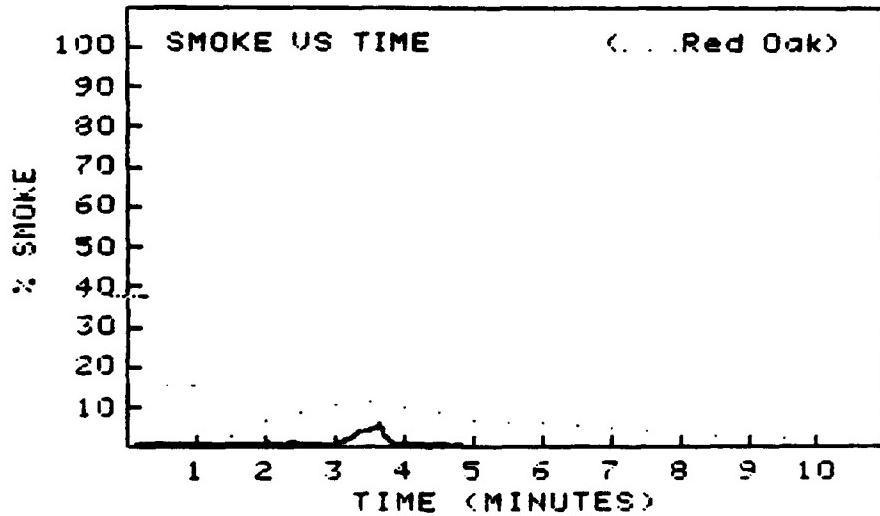
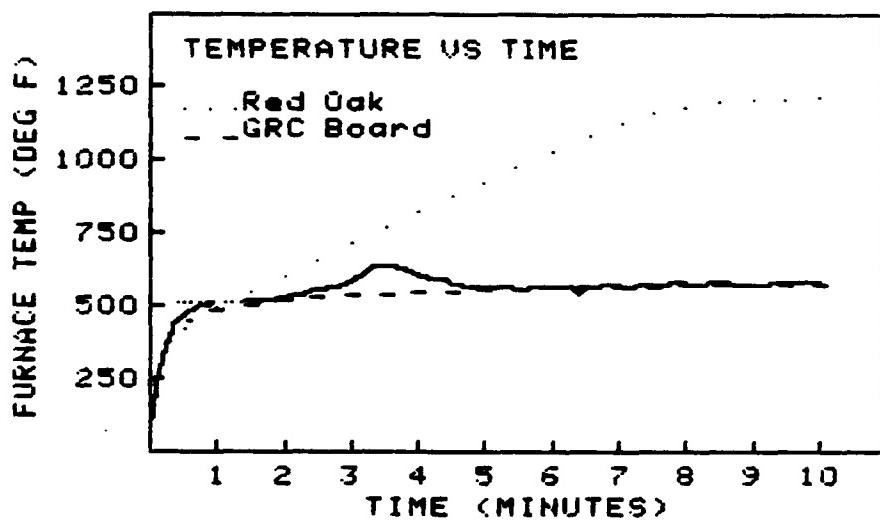
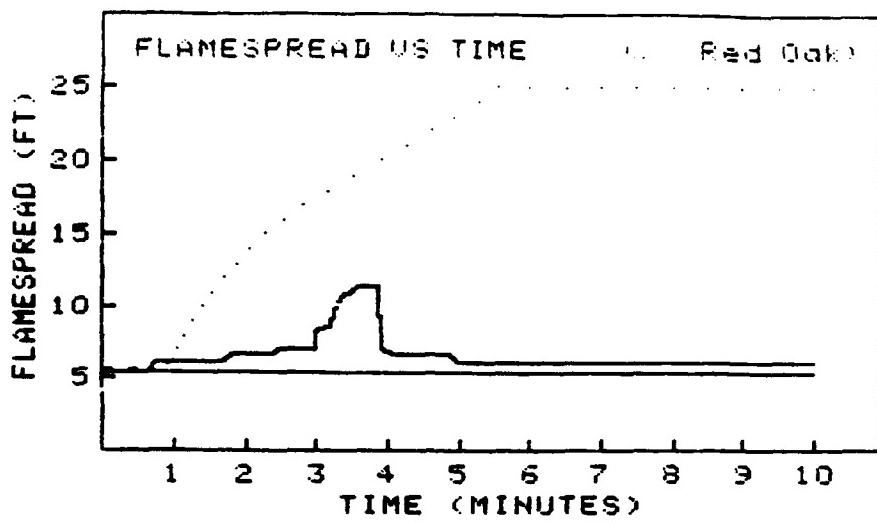


FIGURE C-2 - MATERIAL (2)

MATERIAL (3)

DESCRIPTION

Material: M3, Composite Laminate  
Identification: 164.012/29/0  
Cure Time: 12 days  
Date of Test: 12 November 1986

CLASSIFICATION

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke developed
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
Melamine Laminate	5	0	0

OBSERVATIONS

Event	Min:Sec	Damage	m (ft)
Steady Ignition	0:45	Consumed	1.53 (5.0)
Blisters	0:45		
Peeling	0:46	Blisters	2.44 (8.0)
Pieces Falling	1:22		
Max. Flame Advance 1.98 m (6.5 ft)	1.45	Peeling and Face Char	2.14 (7.0)
		Discoloration	7.63 (25.0)
Afterflame	None		

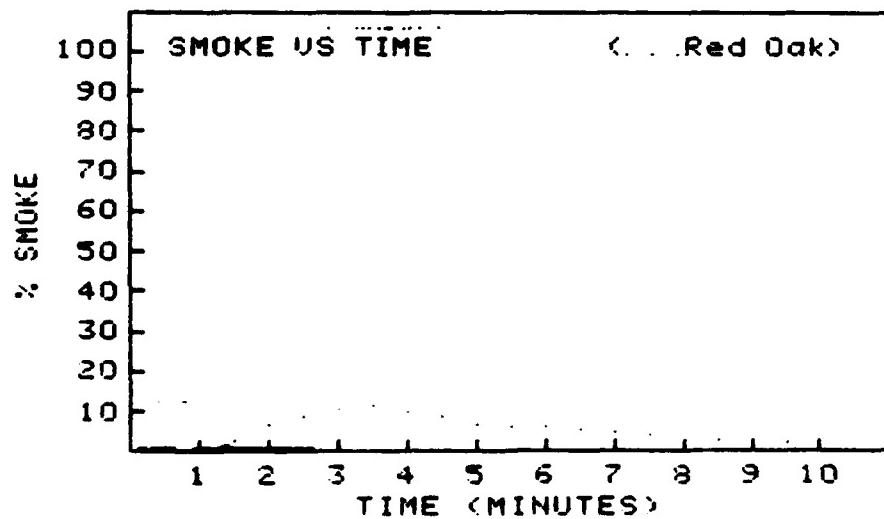
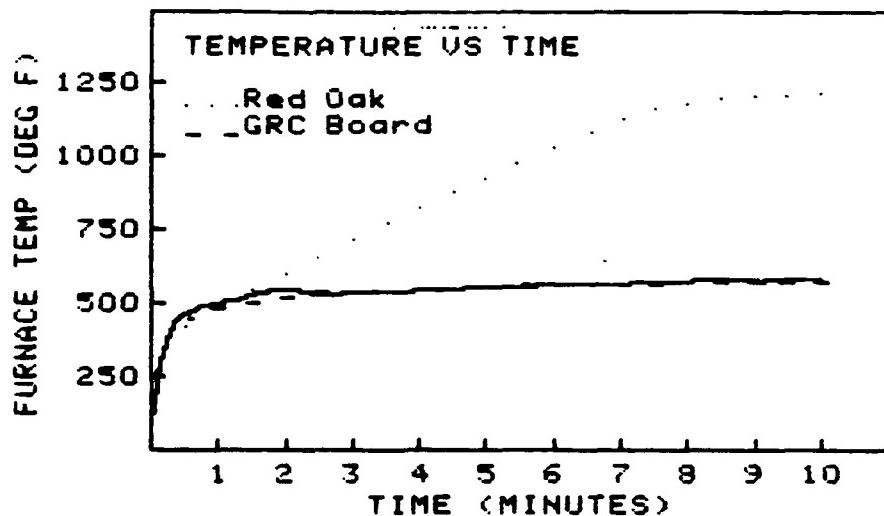
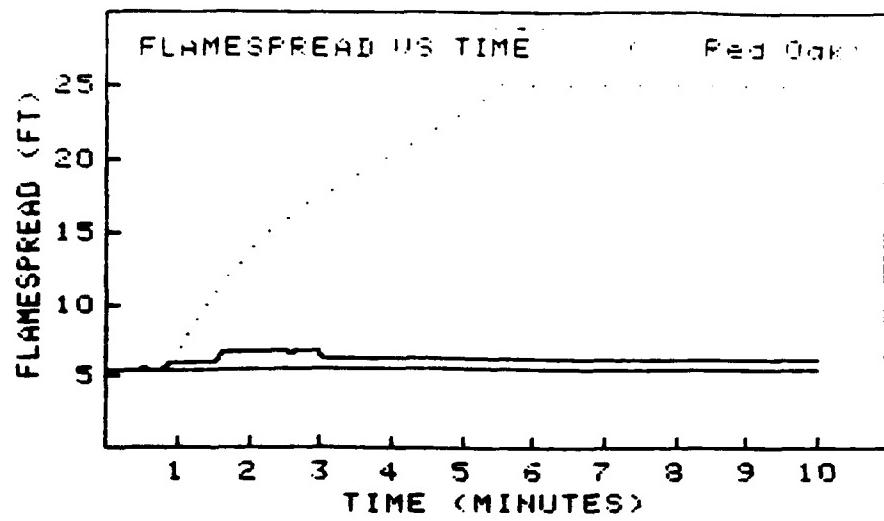


FIGURE C-3 - MATERIAL (3)

**MATERIAL (4)****DESCRIPTION**

**Material:** M4, Coating  
**Identification:** 164.012/19/0  
**Cure Time:** 34 days  
**Date of Test:** 12 November 1986

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
Acrylic Coating	5	0	0

**OBSERVATIONS**

Event	Min:Sec	Damage	m (ft)
Steady Ignition	0:25	Consumed	1.07 (3.5)
Blisters	0:31		
Cracks	6:30	Blisters	3.05 (10.0)
Max. Flame Advance 1.98 m (6.5 ft)	7:30	Heavy Char	1.22 (4.0)
		Face Char	2.29 (7.5)
Afterflame	None	Discoloration	7.63 (25.0)

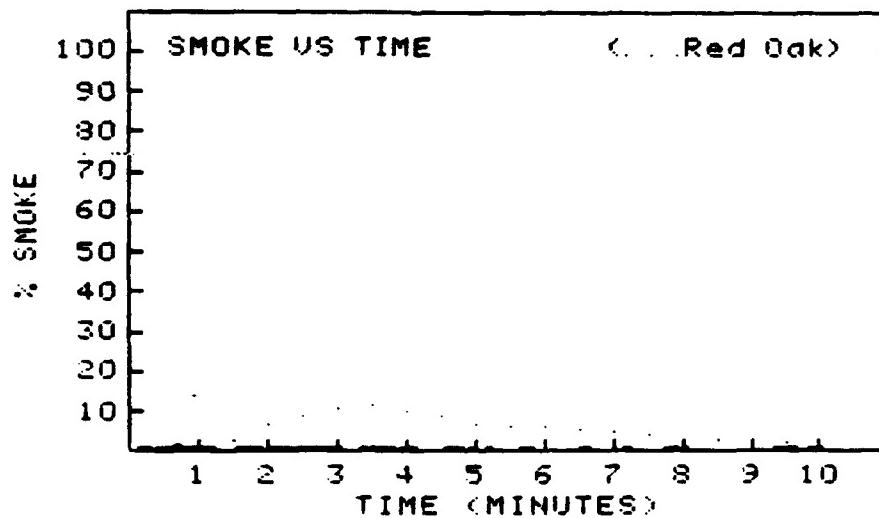
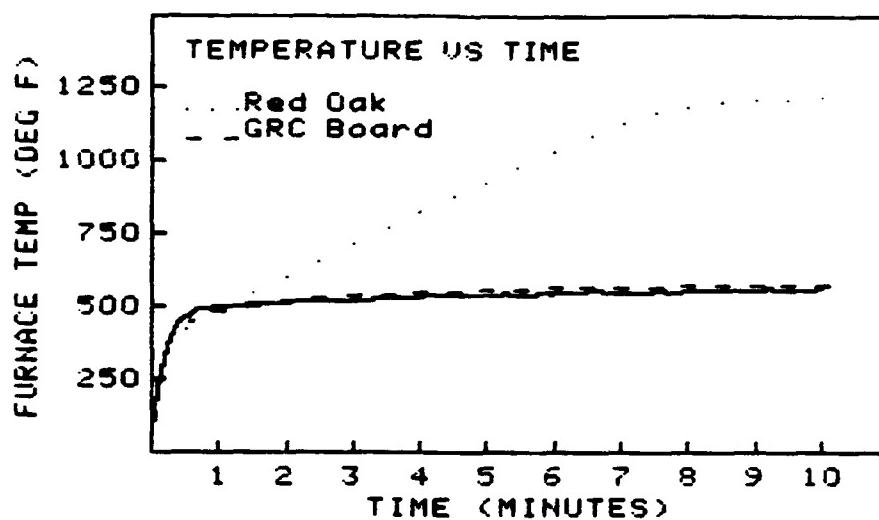
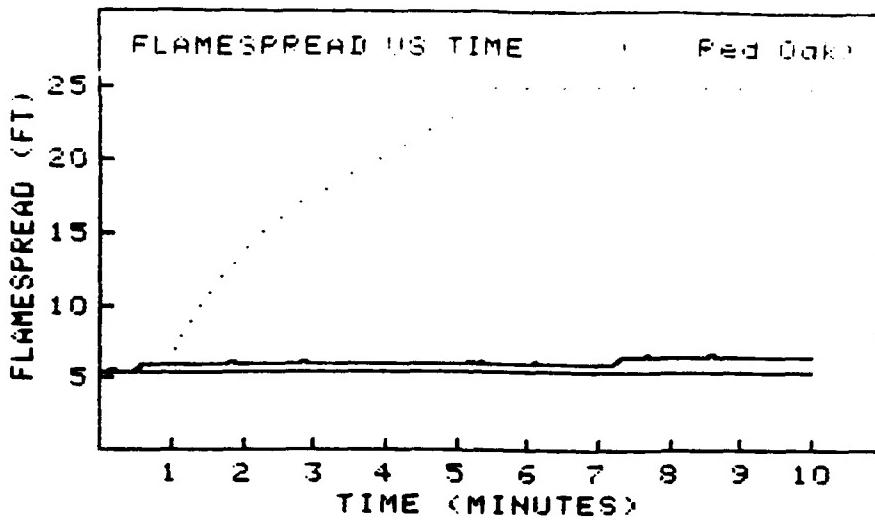


FIGURE C-4 - MATERIAL (4)

**MATERIAL (5)****DESCRIPTION**

**Material:** M5, Coating  
**Identification:** 164.012/79/0  
**Cure Time:** 34 days  
**Date of Test:** 12 November 1986

**CLASSIFICATION**

<b>Test Specimen</b>	<b>Flame Spread E84-84</b>	<b>Fuel Contribution</b>	<b>Smoke Developed</b>
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
General Purpose Coating	15	5	5

**OBSERVATIONS**

<b>Event</b>	<b>Min:Sec</b>	<b>Damage</b>	<b>m (ft)</b>
Steady Ignition	0:19	Consumed	1.22 (4.0)
Blisters	0:18		
Peeling	1:25	Blisters	6.56 (21.5)
Cracks	1:24		
Max. Flame Advance 2.75 m (9.0 ft)	1:30	Heavy Char	1.37 (4.5)
		Face Char	1.68 (5.5)
Afterflame	None	Discoloration	7.63 (25.0)

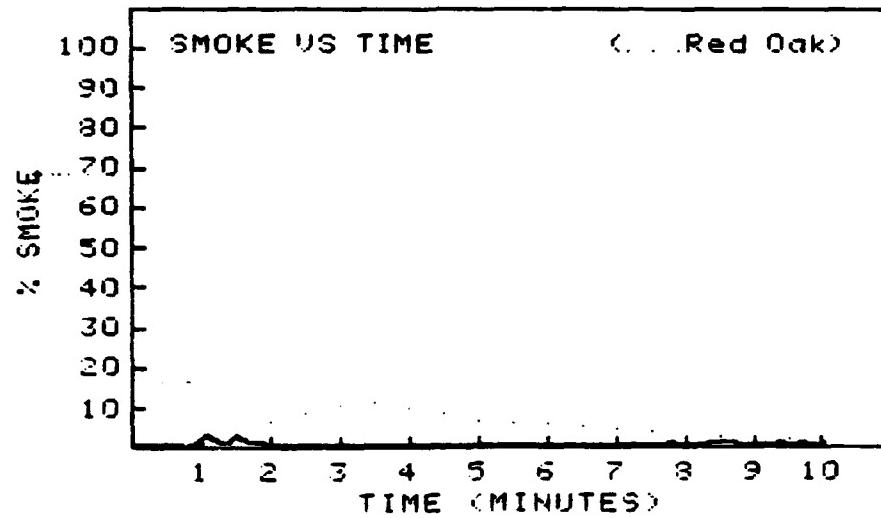
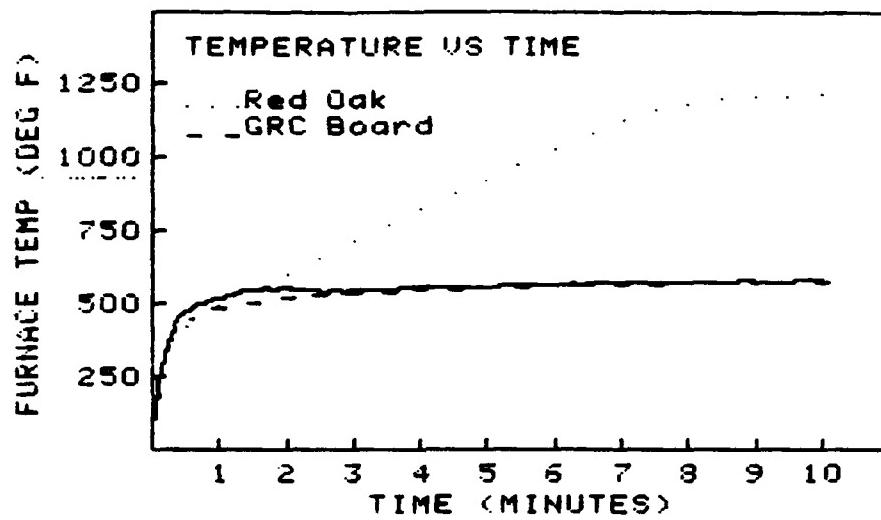
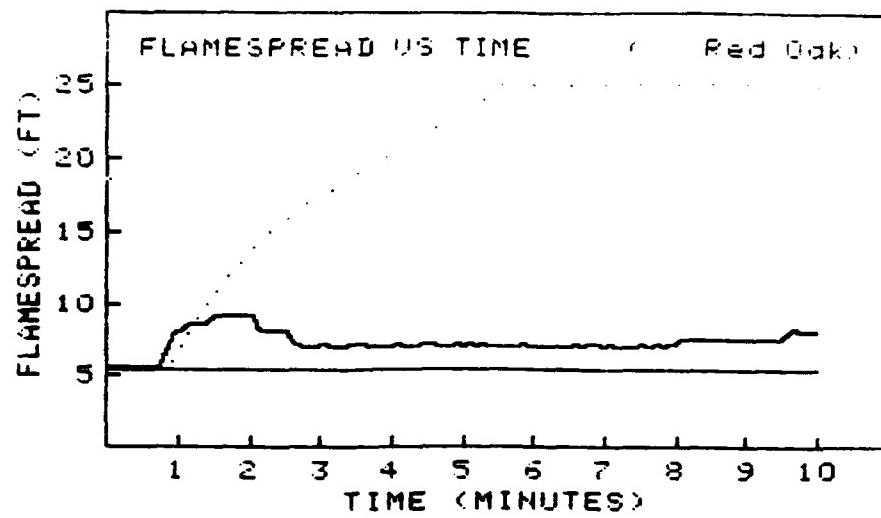


FIGURE C-5 - MATERIAL (5)

**MATERIAL (6)****DESCRIPTION**

**Material:** M6, Coating  
**Identification:** 164.012/28/0  
**Cure Time:** 35 days  
**Date of Test:** 12 November 1986

**CLASSIFICATION**

<b>Test Specimen</b>	<b>Flame Spread E84-84</b>	<b>Fuel Contribution</b>	<b>Smoke Developed</b>
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
General Purpose Coating	5	0	5

**OBSERVATIONS**

<b>Event</b>	<b>Min:Sec</b>	<b>Damage</b>	<b>m (ft)</b>
Steady Ignition	0:16	Consumed	0.92 (3.0)
Blisters	0:20		
Cracks	9:12	Blisters	7.32 (24.0)
Max. Flame Advance 2.14 m (7.0 ft)	7:30	Heavy Char	1.68 (5.5)
		Face Char, ft	2.44 (8.0)
Afterflame	None	Discoloration	7.63 (25.0)

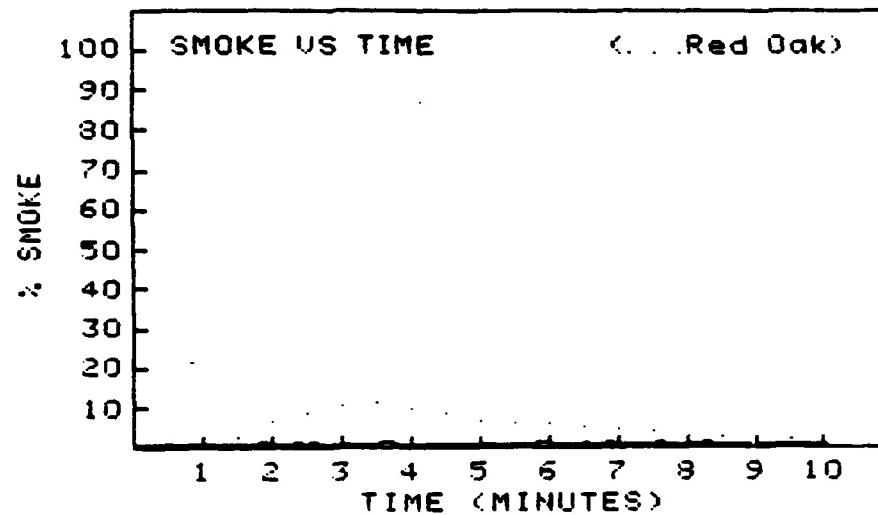
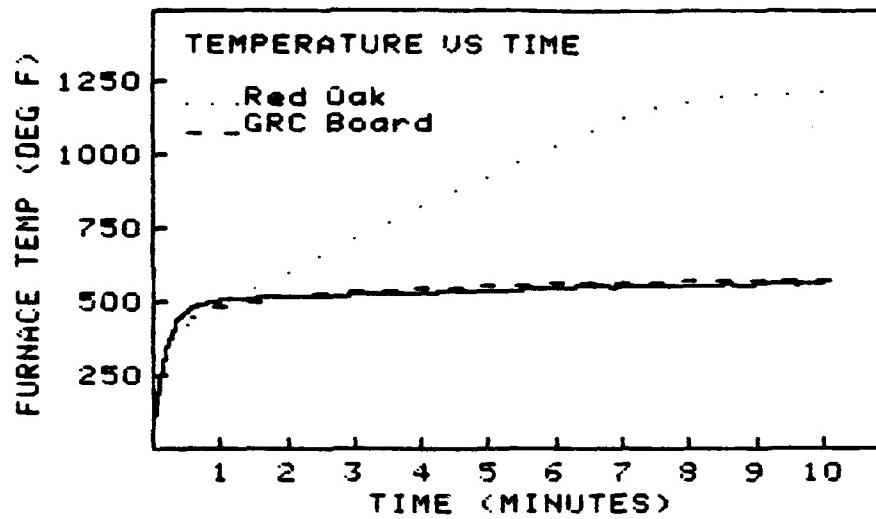
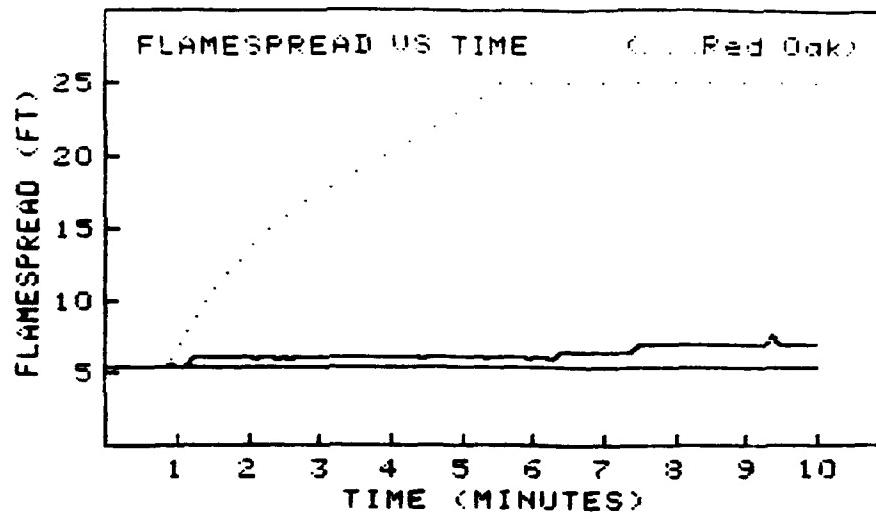


FIGURE C-6 - MATERIAL (6)

**MATERIAL (7)****DESCRIPTION**

**Material:** M7, Fiberglass Reinforced Composite  
**Identification:** 164.012/50/0  
**Cure Time:** 23 days  
**Date of Test:** 12 November 1986

**CLASSIFICATION**

<b>Test Specimen</b>	<b>Flame Spread E84-84</b>	<b>Fuel Contribution</b>	<b>Smoke Developed</b>
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
Fiberglass Reinforced Finish	5	0	5

**OBSERVATIONS**

<b>Event</b>	<b>Min/Sec</b>	<b>Damage</b>	<b>m (ft)</b>
Steady Ignition	0:07	Consumed	0.92 (3.0)
Blisters	0:59		
Max. Flame Advance	7:00	Blisters	6.41 (21.0)
2.14 m (7.0 ft)		Heavy Char	1.68 (5.5)
Afterflame	None	Face Char	2.75 (9.0)
		Discoloration	7.63 (25.0)

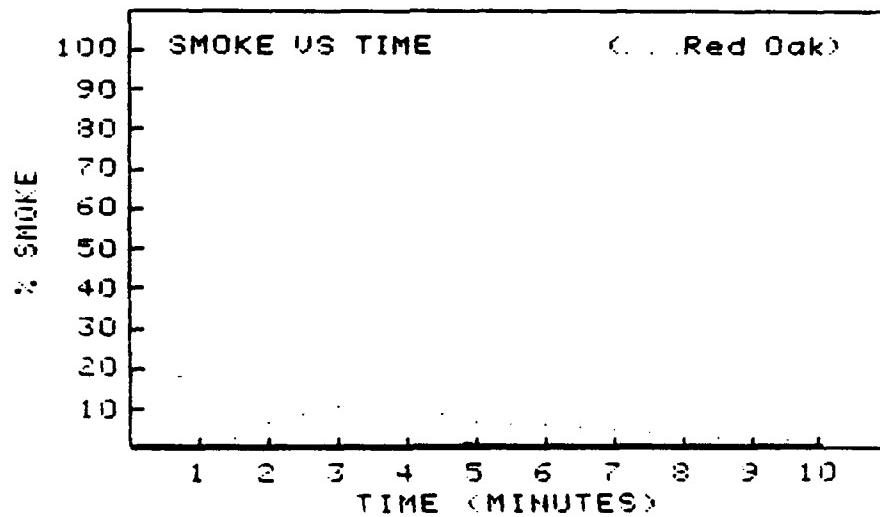
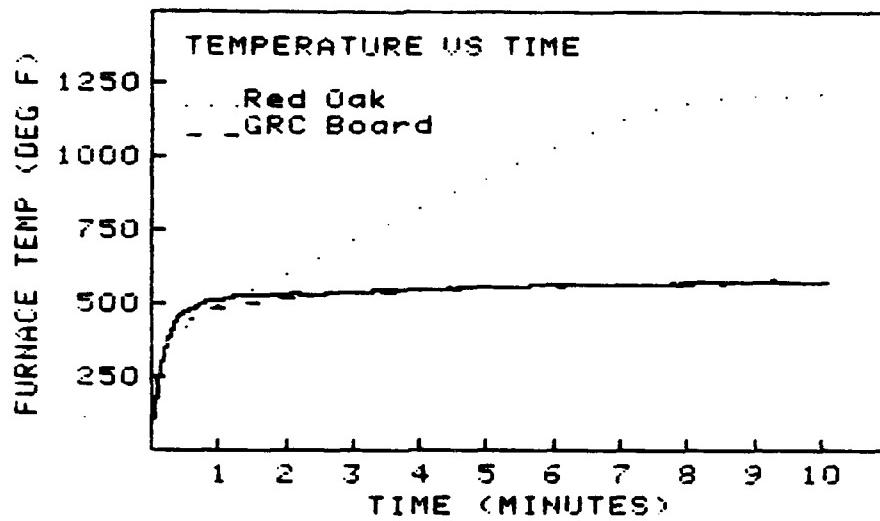
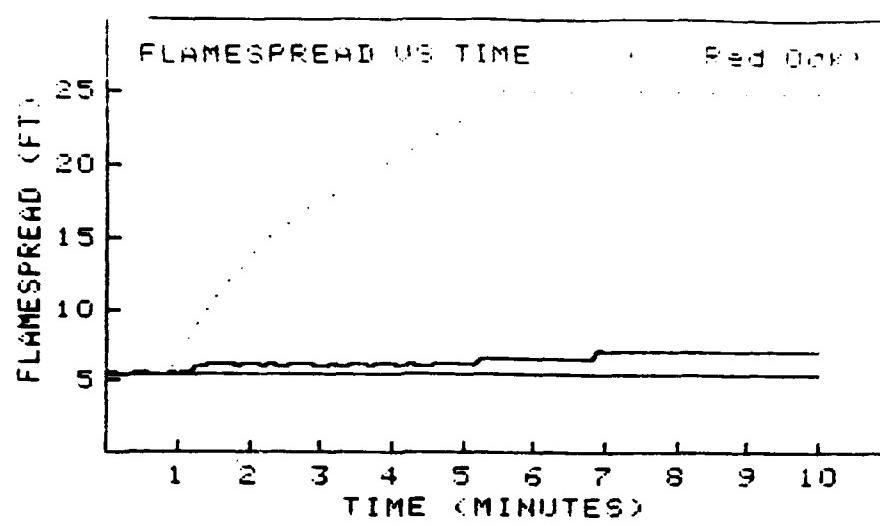


FIGURE C-7 - MATERIAL (7)

MATERIAL (8)

DESCRIPTION

Material: M8 Polyvinylchloride Polymer Film  
Identification: 164.012/17/0  
Cure Time: 23 days  
Date of Test: 12 November 1986

CLASSIFICATION

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
Vinyl Film Wallcovering	5	0	5

OBSERVATIONS

Event	Min:Sec	Damage	m (ft)
Steady Ignition	0:20	Consumed	1.68 (5.5)
Blisters	0:41		
Peeling	4:41	Blisters	7.32 (24.0)
Pieces Falling	7:50		
Max. Flame Advance 1.98 m (6.5 ft)	5:15	Heavy Char	1.98 (6.5)
		Face Char	2.44 (8.0)
Afterflame	None	Discoloration	7.63 (25.0)

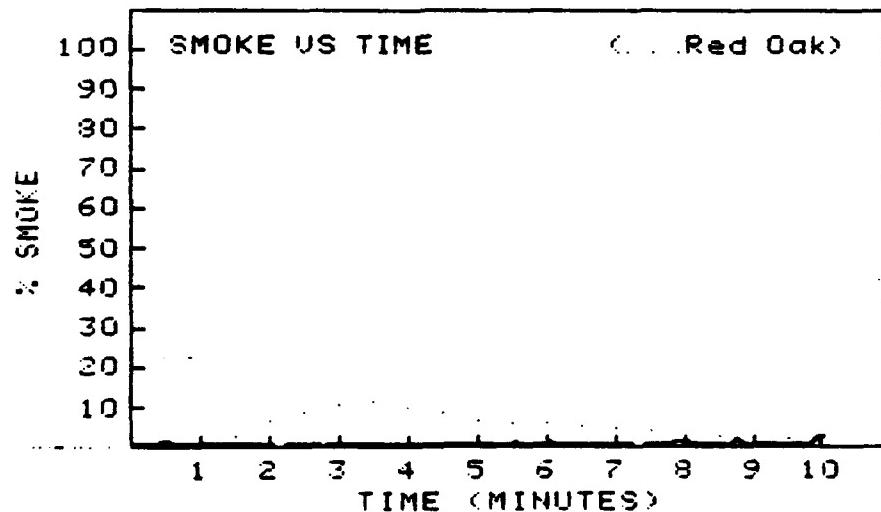
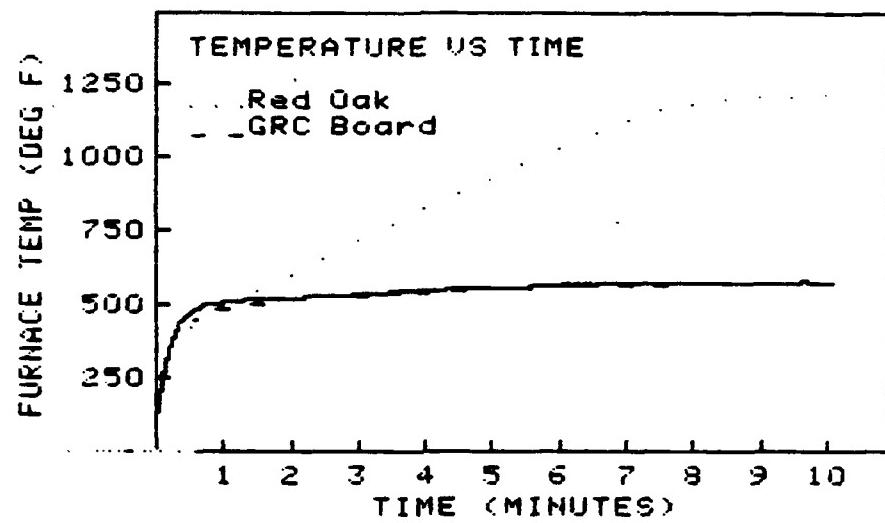
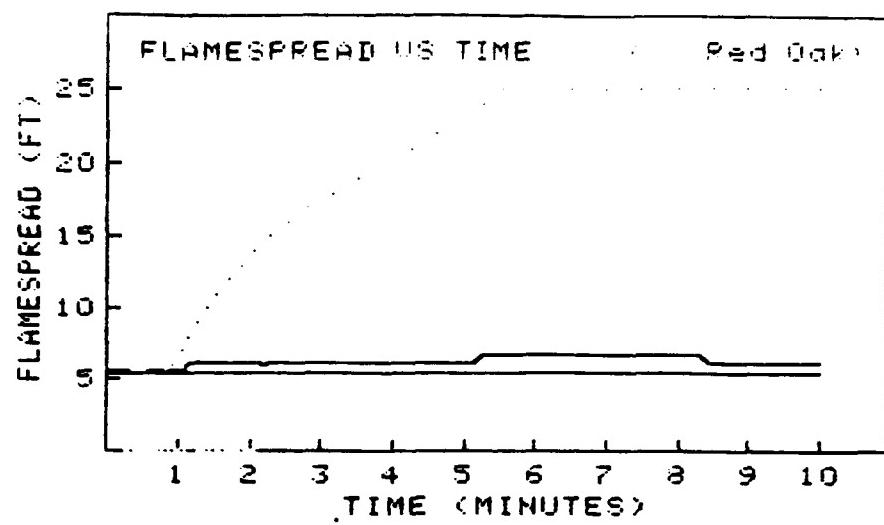


FIGURE C-8 - MATERIAL (8)

**MATERIAL (9)****DESCRIPTION**

**Material:** M9 Polyvinylchloride Polymer Film  
**Identification:** 164.012/21/85/0  
**Cure Time:** 23 days  
**Date of Test:** 12 November 1986

**CLASSIFICATION**

<b>Test Specimen</b>	<b>Flame Spread E84-84</b>	<b>Fuel Contribution</b>	<b>Smoke Developed</b>
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
Embossed Vinyl Wallcovering	5	0	5

**OBSERVATIONS**

<b>Event</b>	<b>Min:Sec</b>	<b>Damage</b>	<b>m (ft)</b>
Steady Ignition	0:19	Consumed	1.07 (3.5)
Blisters	0:41		
Peeling	1:52	Blisters	3.36 (11.0)
Pieces Falling	2:01		
Max. Flame Advance 2.14 m (7.0 ft)	6:30	Heavy Char	10.0 (5.5)
		Face Char	3.05 (10.0)
Afterflame	None	Discoloration	7.63 (25.0)

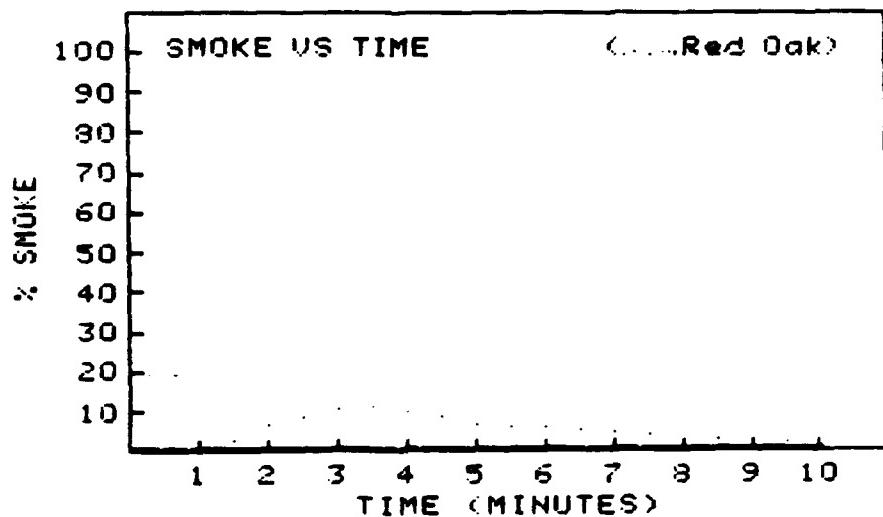
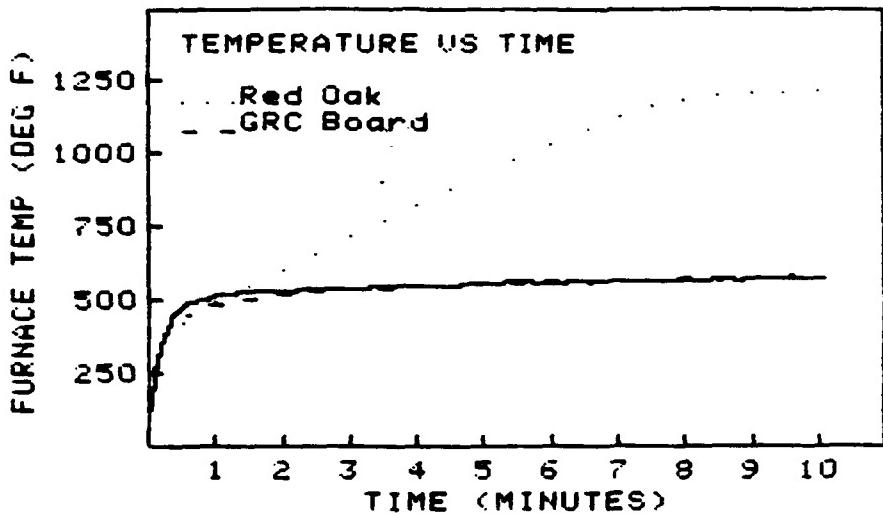
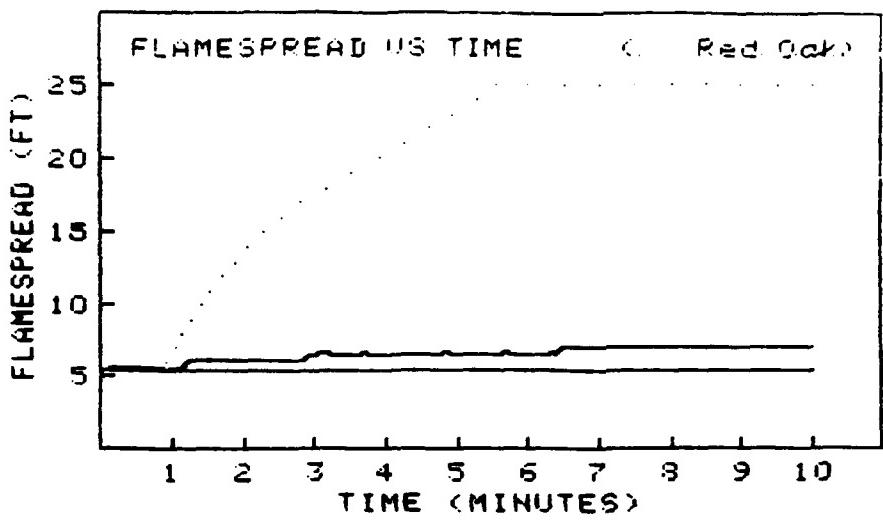


FIGURE C-9 - MATERIAL (9)

**MATERIAL (10)****DESCRIPTION**

**Material:** M10 Polyvinylchloride Polymer Film  
**Identification:** 164.012/72/0  
**Cure Time:** 15 days  
**Date of Test:** 12 November 1986

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	0	0
Red Oak Flooring	100	100	100
Vinyl Film Wallcovering	5	0	5

**OBSERVATIONS**

Event	Min:Sec	Damage Consumed	m (ft)
Steady Ignition	0:15		1.07 (3.5)
Blisters	0:07		
Max. Flame Advance 2.14 m (7.0 ft)	6:15	Blisters	2.59 (8.5)
		Heavy Char	1.68 (5.5)
Afterflame	None	Face Char	2.14 (7.0)
		Discoloration	7.63 (25.0)

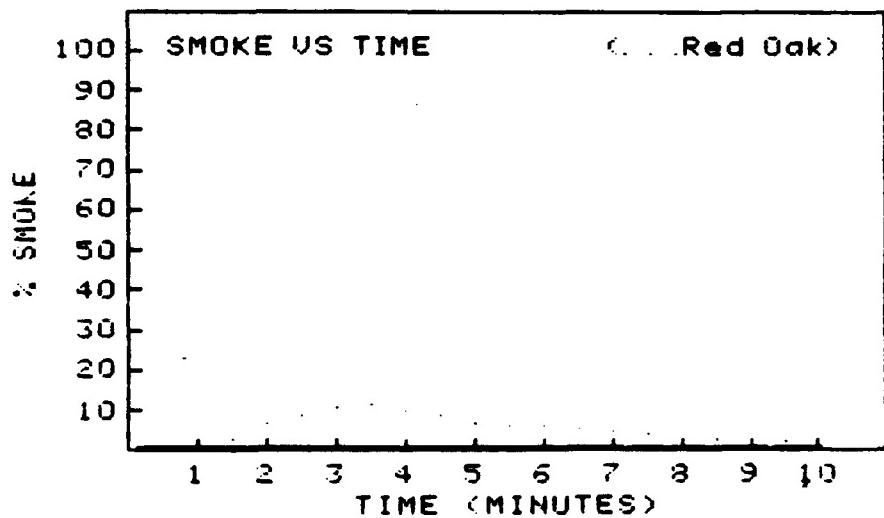
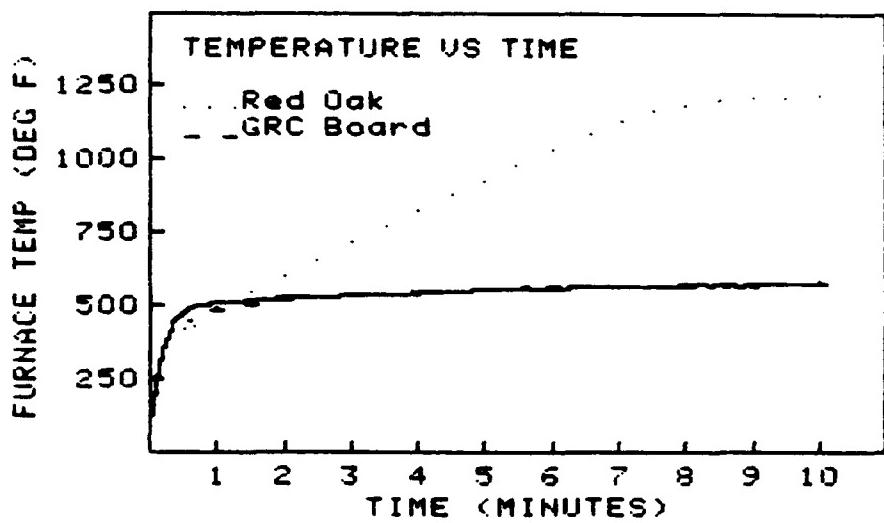
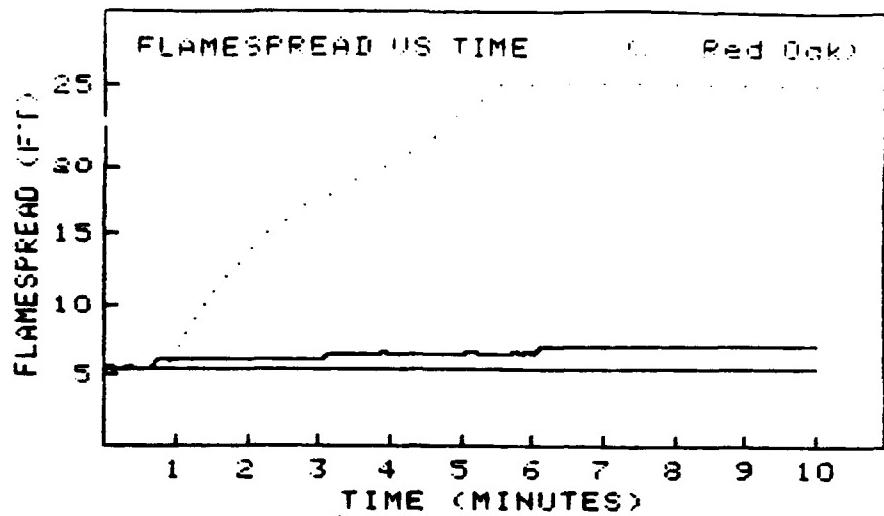


FIGURE C-10 - MATERIAL (10)

**MATERIAL (15)****DESCRIPTION**

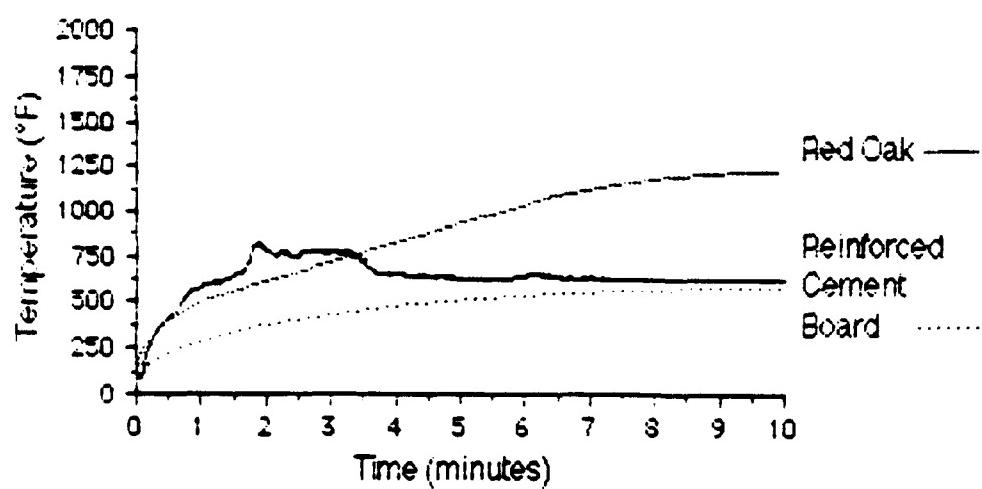
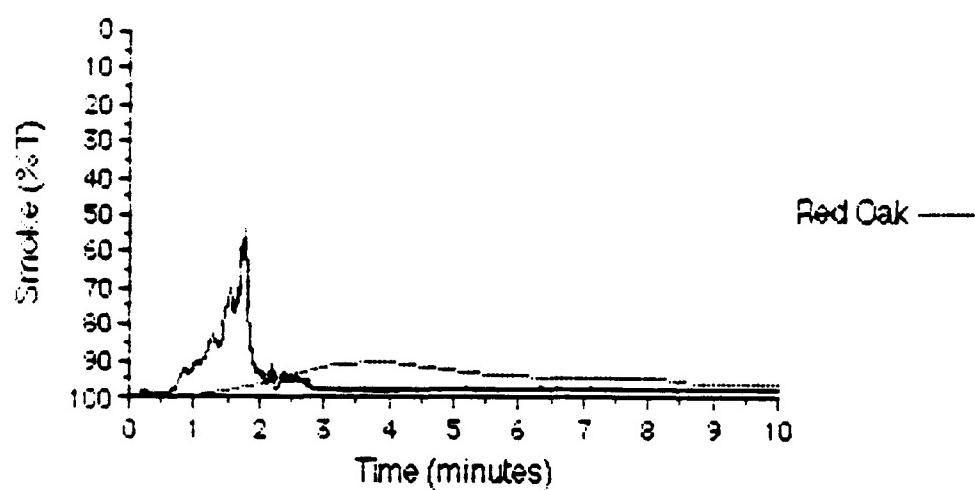
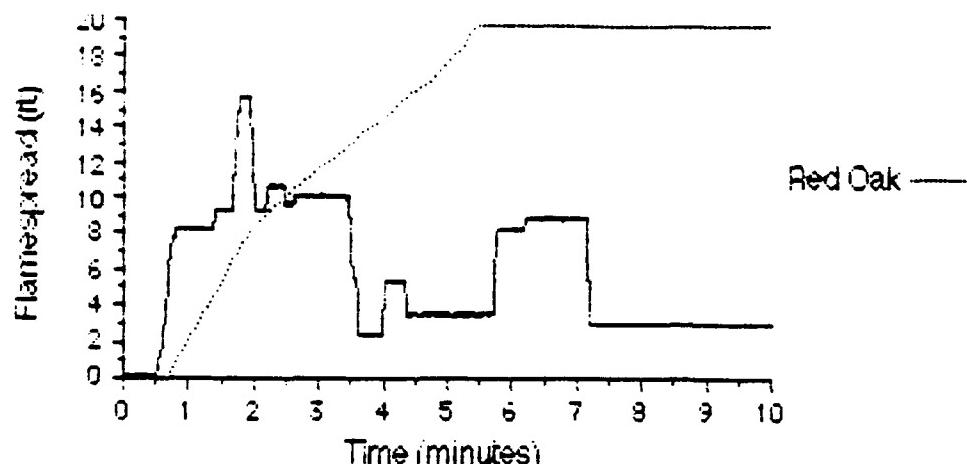
Material: M15, Laminate  
 Identification: None  
 Cure Time: 3 days  
 Date of Test: 20 October 1987

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
Laminate Sheeting, Type 335	85	-----	60

**OBSERVATIONS**

Event	Min:Sec	Damage	m	(ft)
Steady Ignition	0:23	Consumed	4.27	(14.0)
Blisters	0:23	Blisters	5.49	(18.0)
Peeling	0:23	Heavy Char	5.80	(19.0)
Pieces Falling	1:35	Face Char	7.63	(25.0)
Max. Flame Advance 6.56 m (21.5 ft)	2:00	Discoloration	7.63	(25.0)
Afterflame, Top	1:20			
Afterflame, Floor	0:48			



LAMINATE SHEETING: TYPE 335  
FIGURE C-15 - MATERIAL (15)

**MATERIAL (16)****DESCRIPTION**

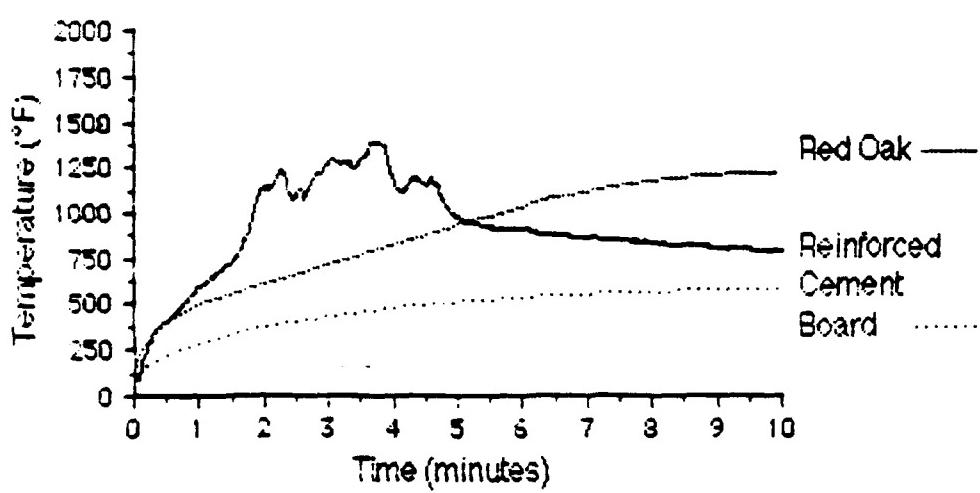
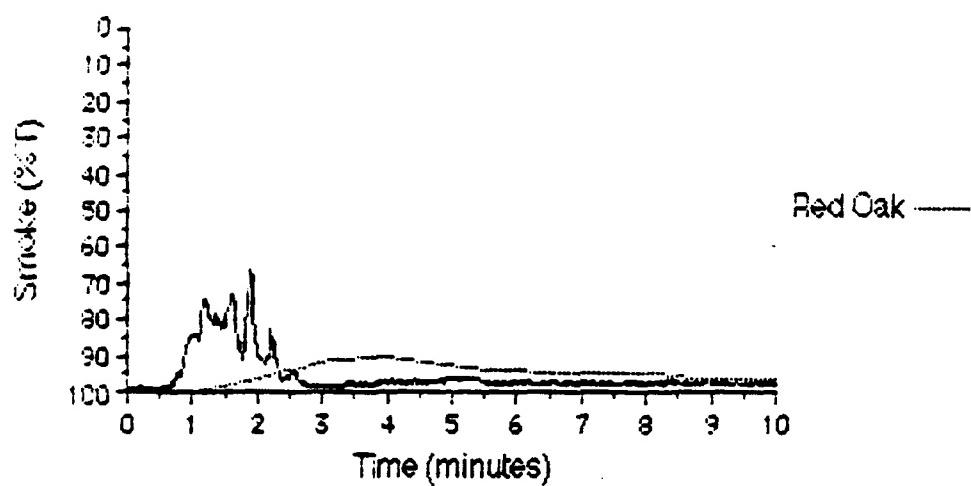
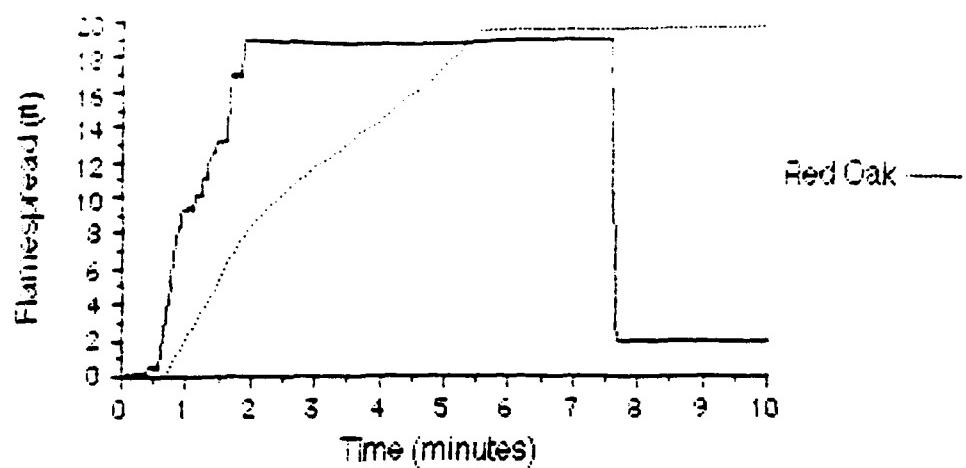
**Material:** M16, Laminate  
**Identification:** None  
**Cure Time:** 3 days  
**Date of Test:** 20 October 1987

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
Laminate sheeting, Type 350	180	-----	70

**OBSERVATIONS**

Event	Min:Sec	Damage	m (ft)
Steady Ignition	0:24	Consumed	7.63 (25.0)
Blisters	0:24	Blisters	
Peeling	0:32	Heavy Char	
Pieces Falling	2:00	Face Char	
Max. Flame Advance 7.63 m (25.0 ft)	2:25	Discoloration	
Afterflame, Top	--		
Afterflame, Floor	--		



LAMINATE SHEETING: TYPE 350  
FIGURE C-16 - MATERIAL (16)

MATERIAL (17)

DESCRIPTION

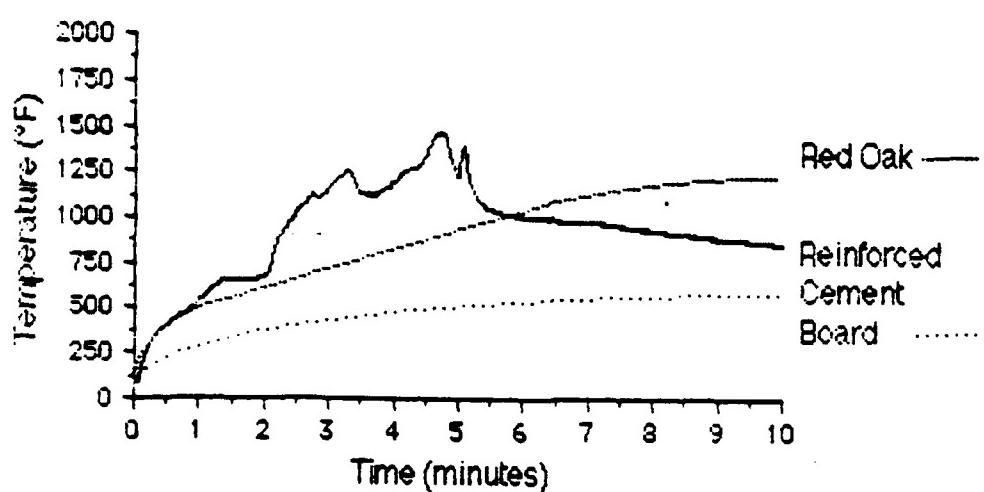
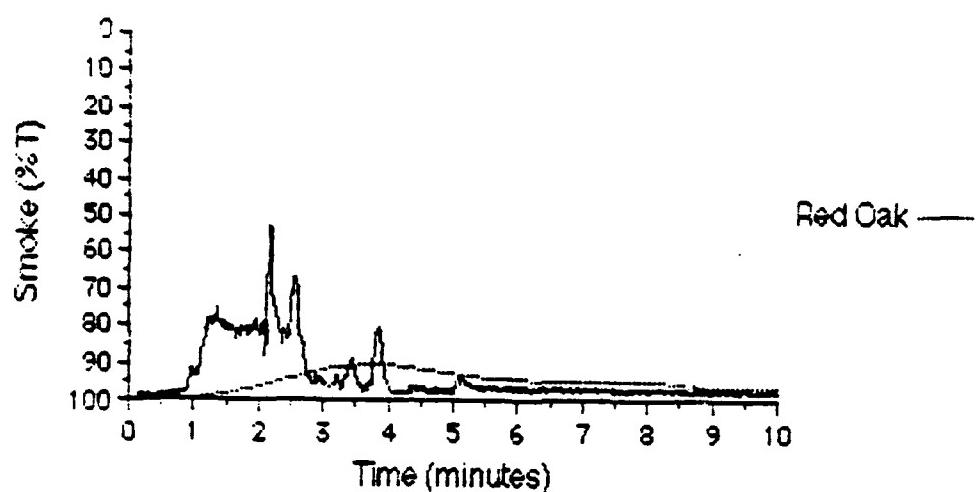
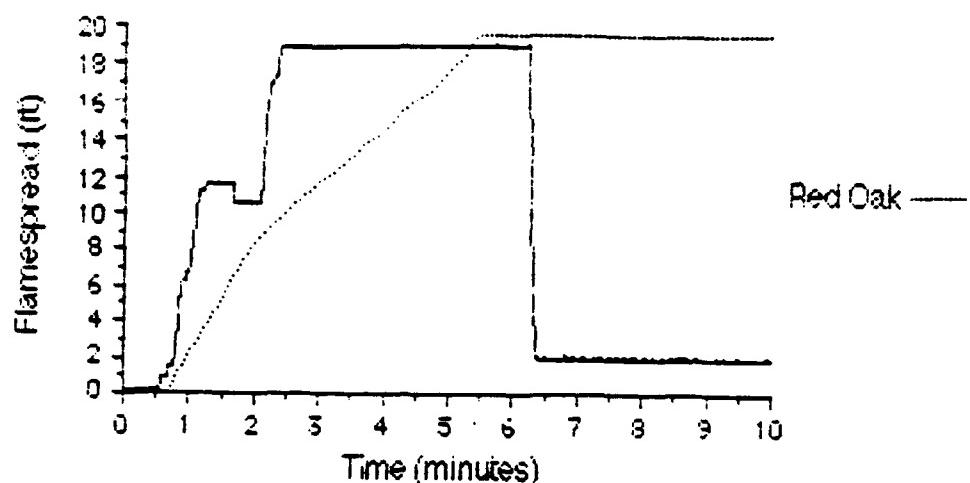
Material: M17, Laminate  
Identification: None  
Cure Time: 2 days  
Date of Test: 19 October 1987

CLASSIFICATION

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
A Laminate Sheeting: Type 107	150	-----	100

OBSERVATIONS

Event	Min:Sec	Damage	m (ft)
Steady Ignition	0:23	Consumed	7.63 (25.0)
Blisters	0:27	Blisters	
Peeling	0:35	Heavy Char	
Pieces Falling		Face Char	
Max. Flame Advance 7.63 m (25.0 ft)	2:30	Discoloration	
Afterflame, Top			
Afterflame, Floor			



LAMINATE SHEETING: TYPE 107  
FIGURE C-17 - MATERIAL (17)

**MATERIAL (18)****DESCRIPTION**

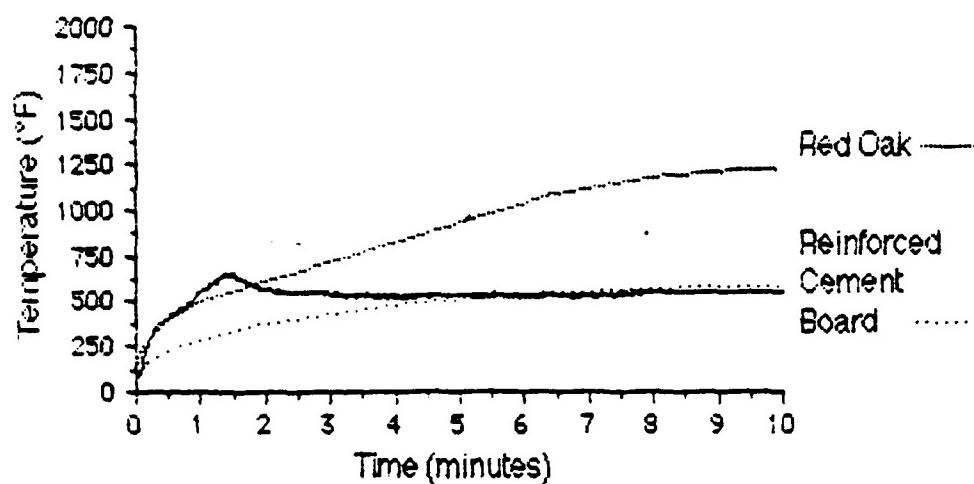
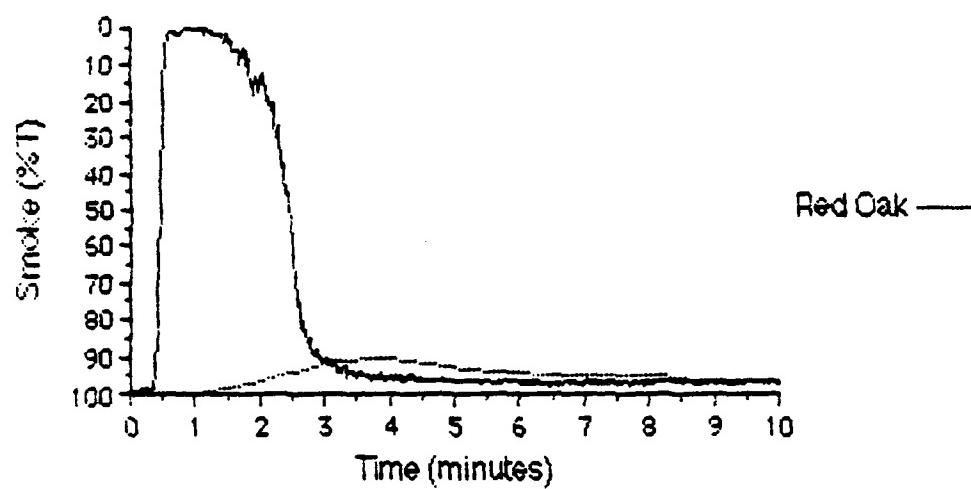
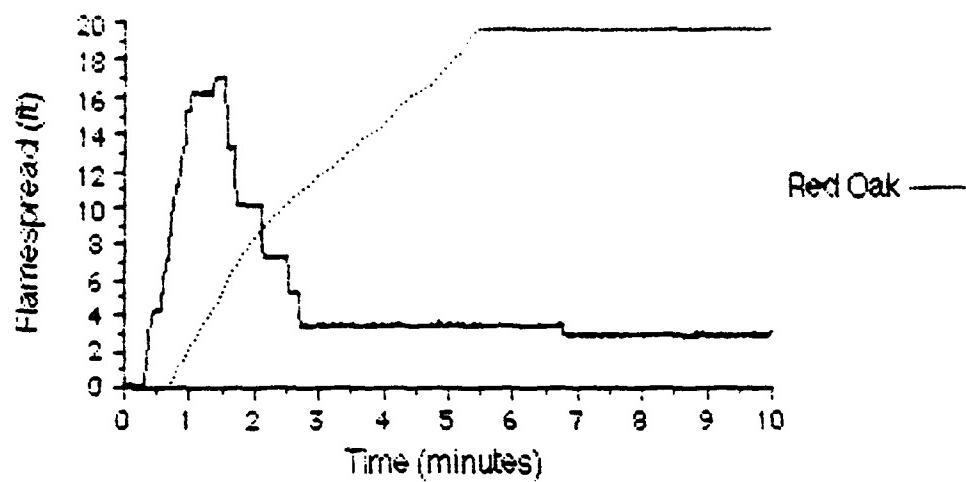
Material: M18, Wall Covering  
 Identification: None  
 Cure Time: 8 days  
 Date of Test: 19 October 1987

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
Vinyl Wall covering, Softee Peel	130	-----	360

**OBSERVATIONS**

Event	Min:Sec	Damage	m	(ft)
Steady Ignition	0:13	Consumed	1.68	(5.5)
Blisters	0:09	Delamination	4.58	(15.0)
Peeling	6:40	Heavy Char	7.63	(25.0)
Pieces Falling	6:45	Discoloration	7.63	(25.0)
Max. Flame Advance 7.02 m (23.0 ft)	1:30	Blisters	7.63	(25.0)
Afterflame, Top				
Afterflame, Floor				



VINYL WALLCOVERING, S. P.  
FIGURE C-18 - MATERIAL (18)

**MATERIAL (19)****DESCRIPTION**

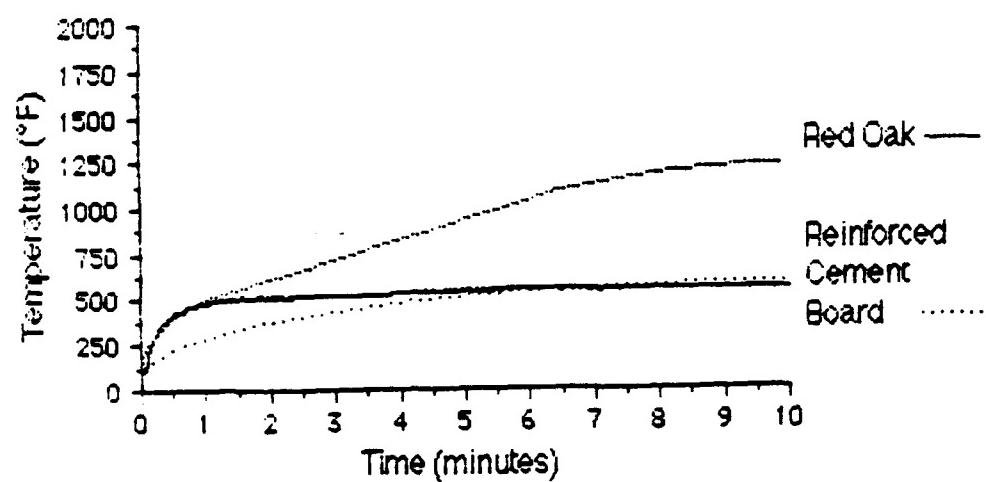
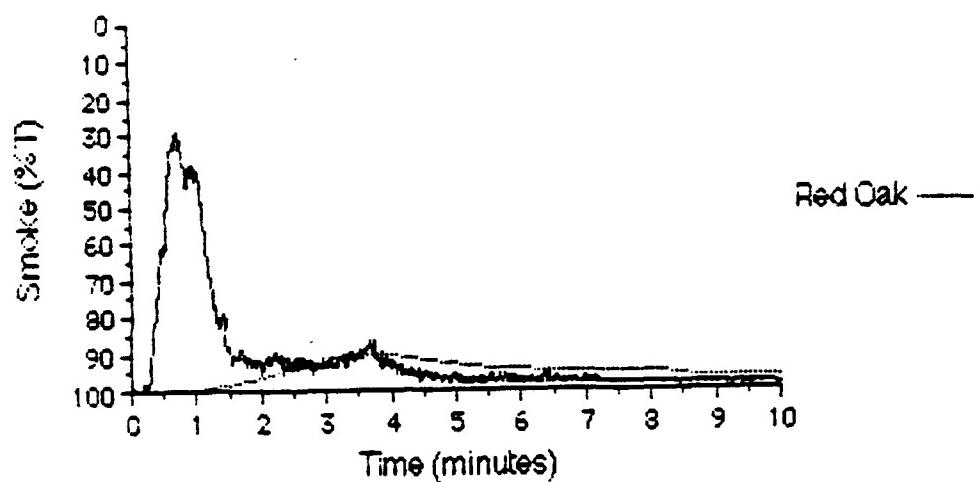
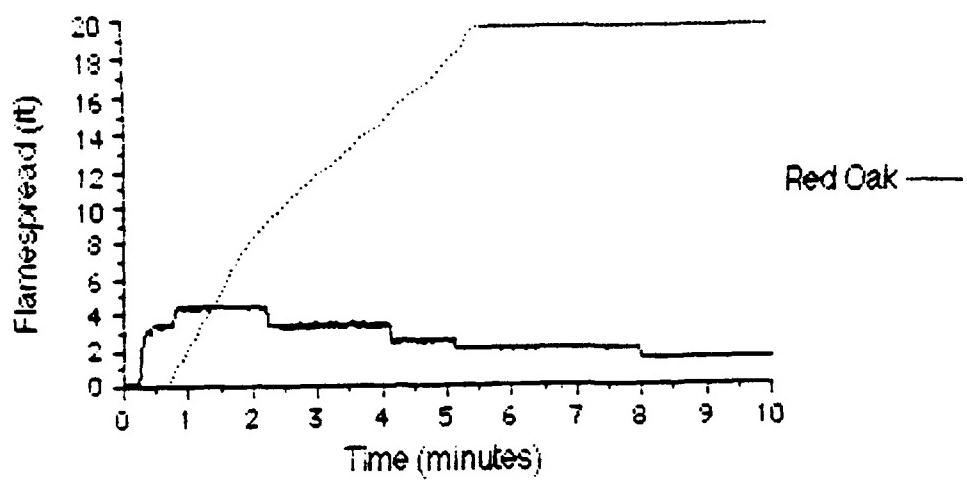
Material: M19, Wall Coveirng  
 Identification: None  
 Cure Time: 38 days  
 Date of Test: 19 October 1987

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
An Embossed Vinyl Wall covering: Type I-G	20	-----	140

**OBSERVATIONS**

Event	Min:Sec	Damage	m	(ft)
Steady Ignition	0:09	Consumed	2.14	(7.0)
Blisters	0:08	Delaminated	3.36	(11.0)
Peeling	0:40	Heavy Char	3.51	(11.5)
Pieces Falling	0:52	Face Char	5.19	(17.0)
Max. Flame Advance 3.05 m (10.0 ft)	1:00	Discoloration	7.63	(25.0)
Afterflame, Top				
Afterflame, Floor				



EMBOSSED VINYL WALLCOVERING:  
TYPE I-G

FIGURE C-19 - MATERIAL (19)

**MATERIAL (20)****DESCRIPTION**

Material: M20, Wall Covering  
 Identification: None  
 Cure Time: 27 days  
 Date of Test: 19 October 1987

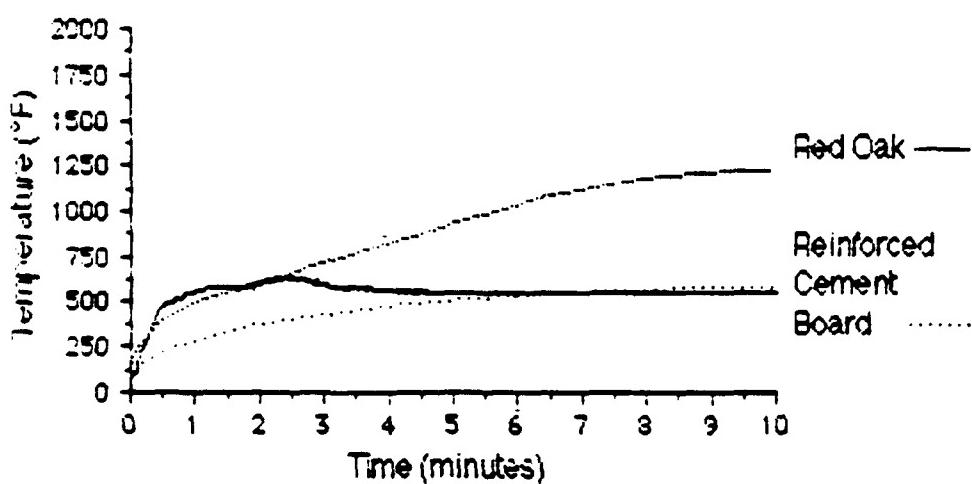
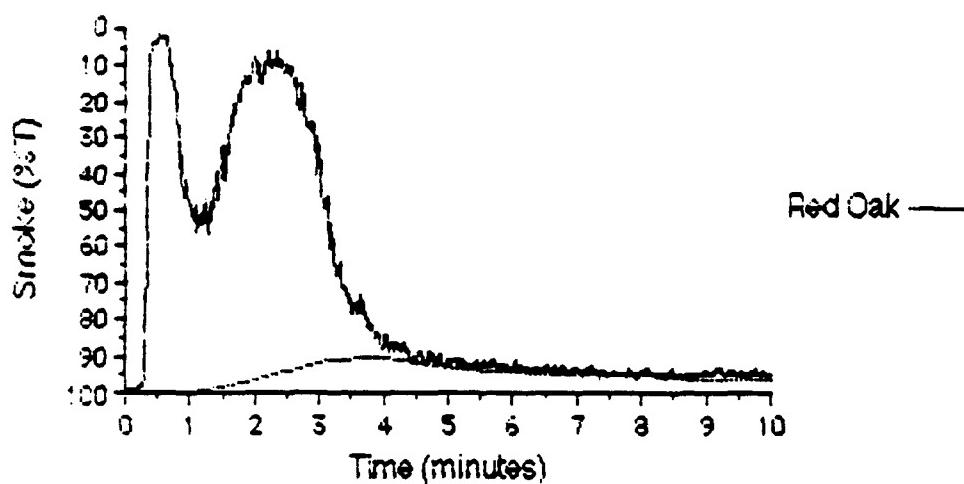
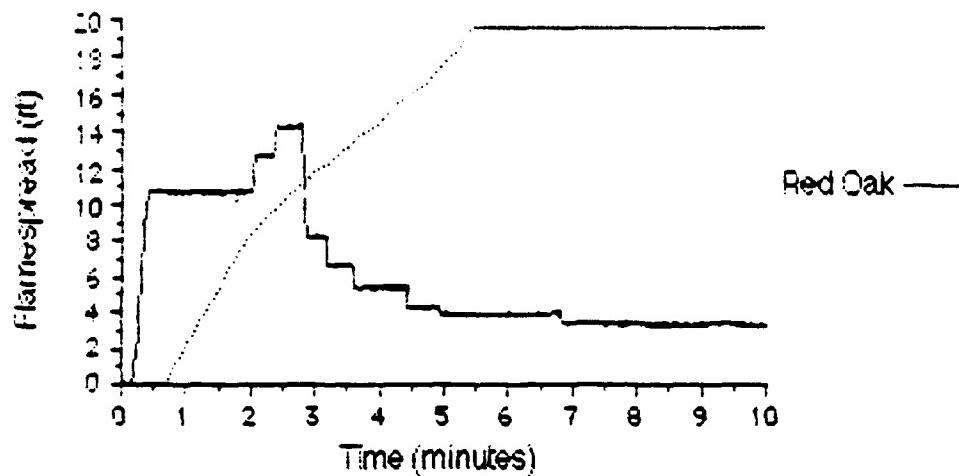
**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
Vinyl Wall Covering/Upholstery With Nonwoven Backing	75	-----	450

**OBSERVATIONS**

Event	Min:Sec	Damage	m	(ft)
Steady Ignition	0:09	Consumed	2.14	(7.0)
Blisters	0:10	Delaminated	5.19	(17.0)
Peeling	0:12	Heavy Char	5.80	(19.0)
Pieces Falling	0:20	Blisters	7.32	(24.0)
Max. Flame Advance 6.10 m (20.0 ft)	2:30	Face Char	7.63	(25.0)
Afterflame, Top		Discoloration	7.63	(25.0)
Afterflame, Floor				

(last page)



VINYL WALLCOVERING/UPHOLSTERY:  
NO IDENTIFICATION

FIGURE C-20 - MATERIAL (20)

**MATERIAL (21)****DESCRIPTION**

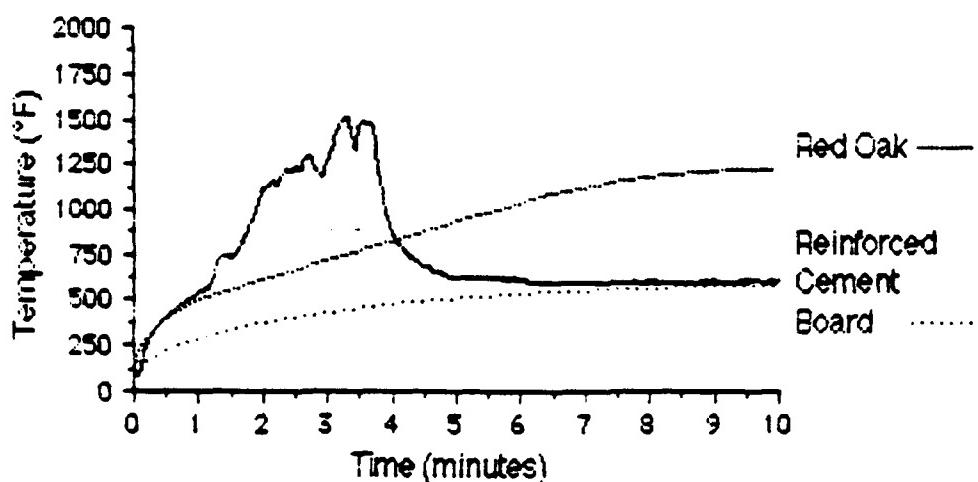
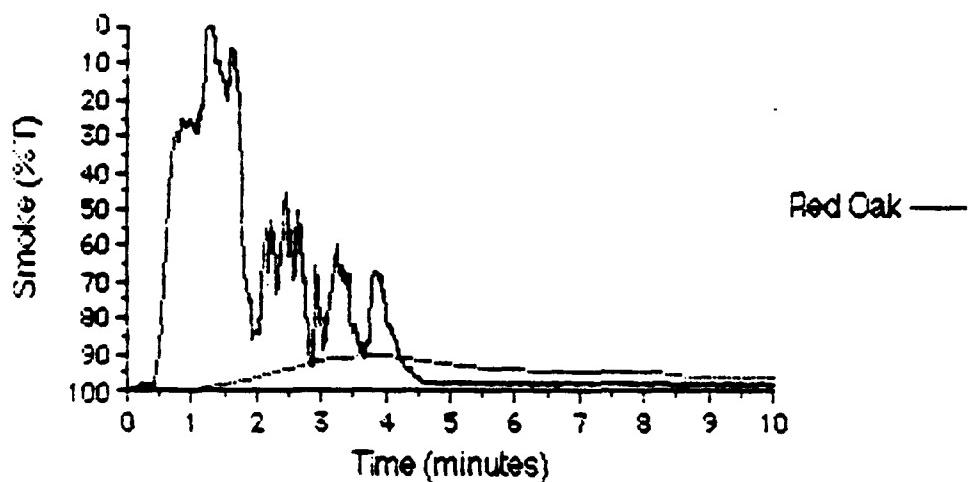
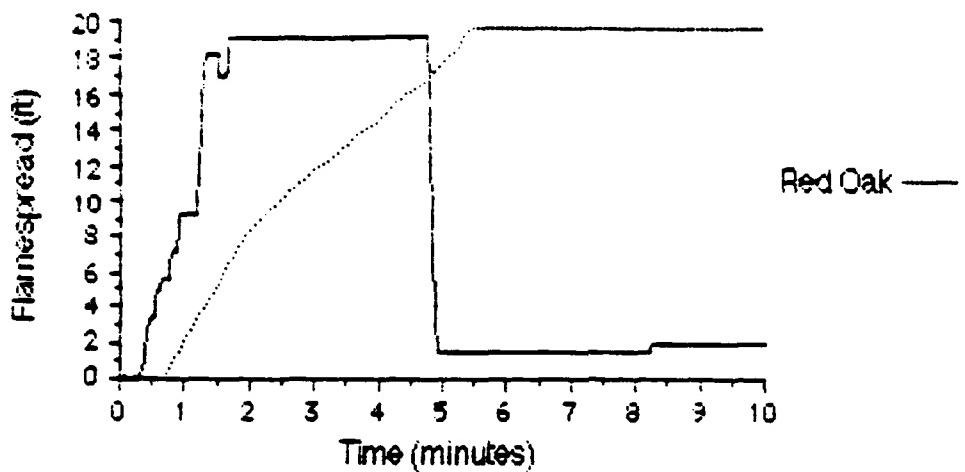
Material: M21  
 Identification: None  
 Cure Time: 9 days  
 Date of Test: 19 October 1987

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
General Purpose Coating, 590 LO-PERM	220	-----	285

**OBSERVATIONS**

Event	Min:Sec	Damage	m	(ft)
Steady Ignition	0:17	Consumed	7.63	(25.0)
Blisters	0:06	Delaminated		
Peeling	0:44	Heavy Char		
Pieces Falling	0:44	Blisters		
Max. Flame Advance 7.63 m (25.0 ft)	1:45	Face Char		
Afterflame, Top		Discoloration		
Afterflame, Floor				



GENERAL PURPOSE COATING:  
590 LO-PERM

FIGURE C-21 - MATERIAL (21)

**MATERIAL (22)****DESCRIPTION**

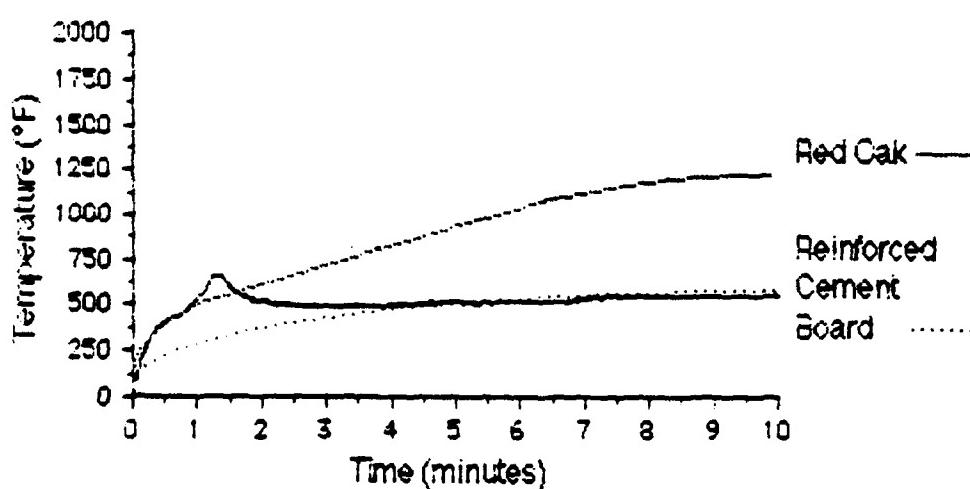
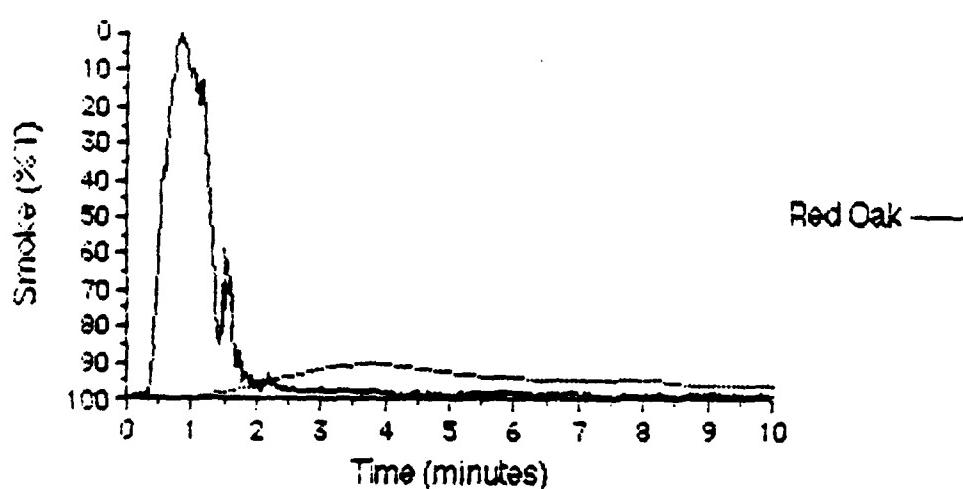
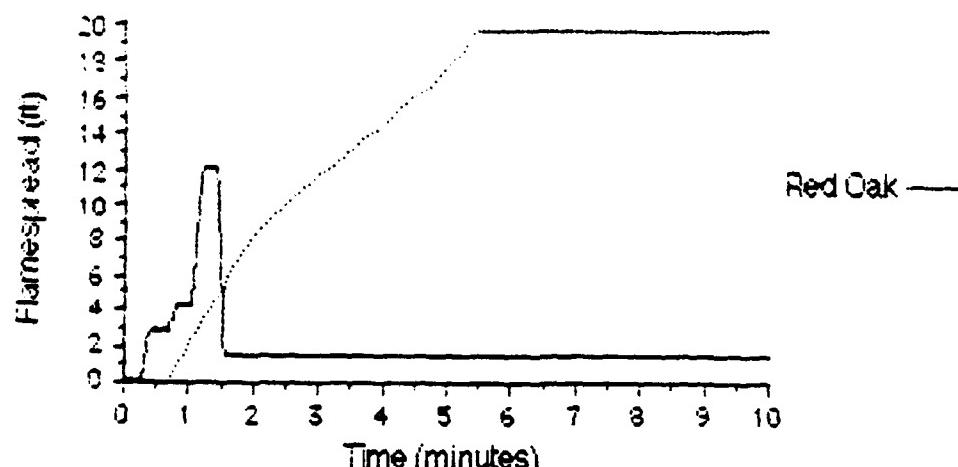
Material: M22, Coating  
 Identification: None  
 Cure Time: 25 days  
 Date of Test: 19 October 1987

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
An Acrylic Coating: Type EC102	55	-----	145

**OBSERVATIONS**

Event	Min:Sec	Damage	m	(ft)
Steady Ignition	0:12	Consumed	3.66	(12.0)
Blisters	0:05	Blisters	7.63	(25.0)
Peeling	0:48	Heavy Char	4.58	(15.0)
Pieces Falling	0:52	Face Char	7.63	(25.0)
Max. Flame Advance 5.49 m (18.0 ft)	1:15	Discoloration	7.63	(25.0)
Afterflame, Top				
Afterflame, Floor				



ACRYLIC COATING:  
TYPE EC102, PERM SURE

FIGURE C-22 - MATERIAL (22)

**MATERIAL (23)****DESCRIPTION**

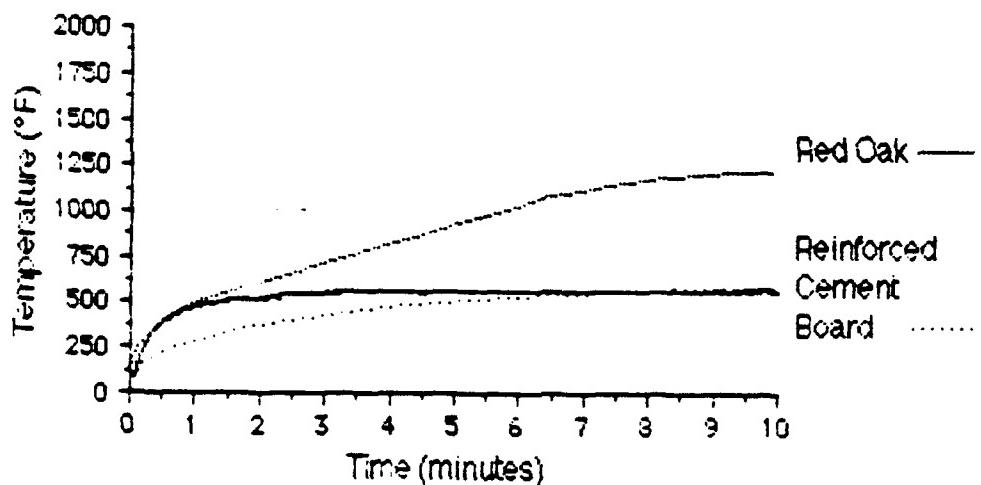
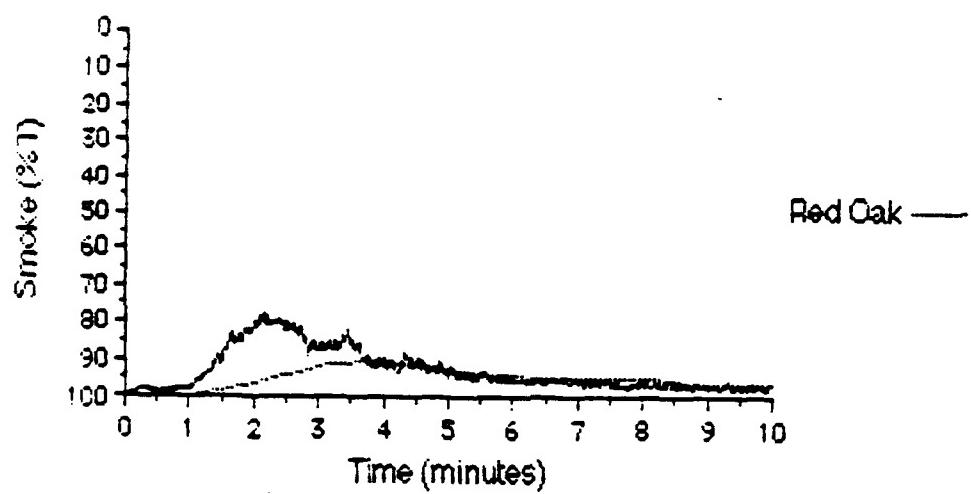
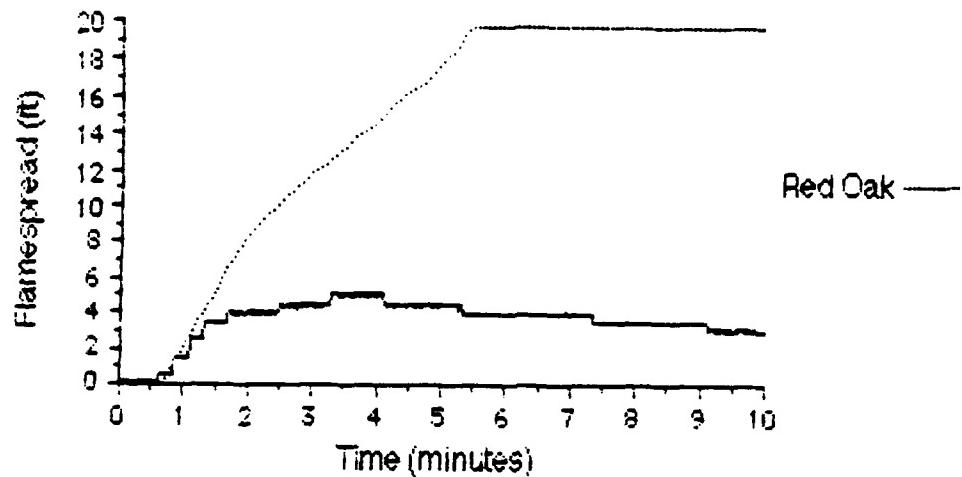
**Material:** M23/Coating  
**Identification:** None  
**Cure Time:** 4 days  
**Date of Test:** 19 October 1987

**CLASSIFICATION**

Test Specimen	Flame Spread E84-84	Fuel Contribution	Smoke Developed
Glass-Reinforced-Cement Board	0	-----	0
Red Oak Flooring	100	-----	100
Mastic Coating, M-04	20	-----	110

**OBSERVATIONS**

Event	Min:Sec	Damage	m	(ft)
Steady Ignition	0:35	Consumed	1.68	(5.5)
Blisters	0:30	Delamination	3.36	(11.0)
Peeling	3:00	Blisters	7.02	(23.0)
Pieces Falling	3:32	Heavy Char	2.75	(9.0)
Max. Flame Advance 3.20 m (10.5 ft)	3:15	Face Char	4.27	(14.0)
Afterflame, Top		Discoloration	7.63	(25.0)
Afterflame, Floor				



GLASS MESH-REINFORCED MASTIC COATING:  
M-04

FIGURE C-23 - MATERIAL (23)

**APPENDIX D**

**IMO Flammability Test Results Under United States Coast Guard  
Contract DTCG23-88-01026 for Tests Conducted at Underwriters  
Laboratories, Inc.**

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## SAMPLES

A total of 12 different samples were evaluated. The samples were comprised of a gypsum core with various laminates adhered to the surfaces. The samples were received with various markings identifying the samples and are described in Table 1.

## METHOD

The tests referenced in this Report were conducted in accordance with Revised Recommendation On Fire Test Procedures For Surface Flammability of Bulkhead and Deck Finish Materials, Resolution A.564(14) adopted on November 20, 1985.

Prior to testing, the radiant panel flux was adjusted based upon calibration curves of millivolts vs. watts for three radiometers located as described below:

Distance from exposed <u>End of Specimen (mm)</u>	Millivolt Reading <u>of Radiometer</u>	Flux Level At <u>Calibration Position (W/cm<sup>2</sup>)</u>
50	18.3	5.05
200	15.4	4.31
350	8.4	2.39

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The calibration curves of millivolts vs. watts for each radiometer are shown in App. A, ILLS. A1, A2 and A3.

All tests were conducted in a vertical orientation and used a nonimpinging pilot flame. A 13 mm thick  $740 \text{ kg/m}^3$  (46.0 pcf) calcium silicate board was used as a backing plate for all of the samples tested.

For each test, a 3 min pretest reading was obtained to monitor kilowatts prior to insertion of the test samples. The values for total heat release and maximum heat release were taken above the average of this 3 min pretest reference line. Any values which may have occurred below the "zero" reference line were not included in the calculation for total heat released.

#### RESULTS

The radiant flux profile, heat for ignition and heat for sustained burning for each test ~~are~~ shown in Table 2. The maximum flame spread, time of maximum flame spread, critical radiant flux at extinguishment, total heat release and maximum heat release, and test duration are provided in Table 3. Graphs of heat release (kW) vs. time (min.) for each test are shown in ILLS. 1-15.

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#### OBSERVATIONS

Due to the large number and variety of samples tested, enclosed with this report are videocassette recordings of each test and post test observations.

#### GENERAL

It should be understood that the results provided herein apply only to the particular samples submitted for testing. The test results indicated in this Report are not intended to imply Listing, Classification or other Recognition of any product or materials.

In no event shall Underwriters Laboratories Inc. be responsible to anyone for whatever use or nonuse is made of the information contained in this Report and in no event shall Underwriters Laboratories Inc., its employees or its agents incur any obligation or liability for damages, including, but not limited to consequential damages arising out of or in connection with the use, or inability to use, the information contained in this Report.

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Should you have any questions or comments on the above, please do not hesitate to contact the undersigned.

Very truly yours,

Reviewed by:

THOMAS R. EBERT (Ext. 3086)  
Project Engineer  
Fire Protection Department

LEON J. PRZYBYLA  
Assistant Managing Engineer  
Fire Protection Department

TRE:ccj

CC: United States Coast Guard  
Research & Development Center  
Marine Fire & Safety Research Division  
Mr. Bill McClain  
Avery Point  
Groton, CT 06340

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TABLE I

Sample Description

Sample	Test	Test			U.S.C.G.
<u>Reference</u>	<u>Date</u>	<u>No.</u>	<u>Identification on Sample</u>		<u>ID No.*</u>
A	7-7-88	1	01-1373-520	M18S5SPZ	M18
			ID: Softee Peel		
			Adh: Casco-Vin E 8825		
			9-11-87		
B	7-7-88	2	WH Micarta PFR-1	USCG870731	M1
			Boredon Chemical	SP2	
			Casco D Hen RS216 Adhesive		
C	7-7-88	3	01-1373-520	M23S6SP2	M23
			ID: M-04		
			Apply 12 oz/bd		
			9-14-87		
D	7-7-88	4	01-1373-520	M20S4SP2	M20
			ID: None		
			Adhesive: Casco-Vin 8825		
			9-22-87		
E	7-7-88	5	01-1373-520	M22S4SP2	M22
			ID: 102 Perm-Sute		
			Apply 2.1 oz/board per coat		
			9-23-87		

\* See Appendix A - Description of Materials

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U.S.C.G.

ID No.\*

F	7-7-88	6	335 CW23-23 Core-Marinate	M15
G	7-7-88	7	107 CW23-23B Core-Marinate	M17
H	7-7-88	8	350 CW23-23A Core-Marinate	M16
I	7-7-88	9	USCG 870731 MD607	M2
J	7-7-88	10	USCG 870731 604MD MD604	M1
K1,K2,K3	8-2-88	11,12,13	8070731	
			MZMDSUL-*SP2	M2
			Type 607	
			(* = 1,2 and 3 respectively)	
L1	8-2-88	14	M9SUL-1SP2	M9
			1.0958 KG Dry	
			1.1246 KG Wet	
			B.F. Goodrich	
L2	8-2-88	15	M9SUL-2SP2	M9
			0.9216 KG Dry	
			0.9516 KG Wet	
			B. F. Goodrich	

\* See Appendix A - Description of Materials

7 DISPLAYWRITER ccj Ebert (RD-ltr rpt) LTRT3 11-16-88  
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TABLE 2

## **Results**

I	Time (sec)	24	24	83	122	200	238	327	-	-	-	-
	Time x Flux (MJ/m <sup>2</sup> )	1.19	1.21	4.13	5.75	8.60	8.85	10.14	-	-	-	-
J	Time (sec)	30	30	37	69	103	-	-	-	-	-	-
	Time x Flux (MJ/m <sup>2</sup> )	1.48	1.52	1.84	3.25	4.43	-	-	-	-	-	-
K1	Time (sec)	21	21	88	107	133	198	-	-	-	-	-
	Time x Flux (MJ/m <sup>2</sup> )	1.04	1.06	4.38	5.04	5.72	7.37	-	-	-	-	-
K2	Time (sec)	22	22	101	120	127	169	336	-	-	-	-
	Time x Flux (MJ/m <sup>2</sup> )	1.09	1.11	5.03	5.65	5.46	6.29	10.42	-	-	-	-
K3	Time (sec)	21	21	89	103	122	164	242	545	-	-	-
	Time x Flux (MJ/m <sup>2</sup> )	1.04	1.06	4.43	4.85	5.25	6.10	7.50	13.41	-	-	-
L1	Time (sec)	10	10	10	10	35	46	52	-	-	-	-
	Time x Flux (MJ/m <sup>2</sup> )	0.49	0.51	0.50	0.47	1.51	1.71	1.61	-	-	-	-
L2	Time (sec)	10	10	10	10	17	25	49	68	-	-	-
	Time x Flux (MJ/m <sup>2</sup> )	0.49	0.51	0.50	0.47	0.73	0.93	1.52	1.67	-	-	-

\* - Radiant flux based upon best fit polynomial equation of calibration values for distance vs. radiant flux.

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LRTT3:ccj

TABLE 3

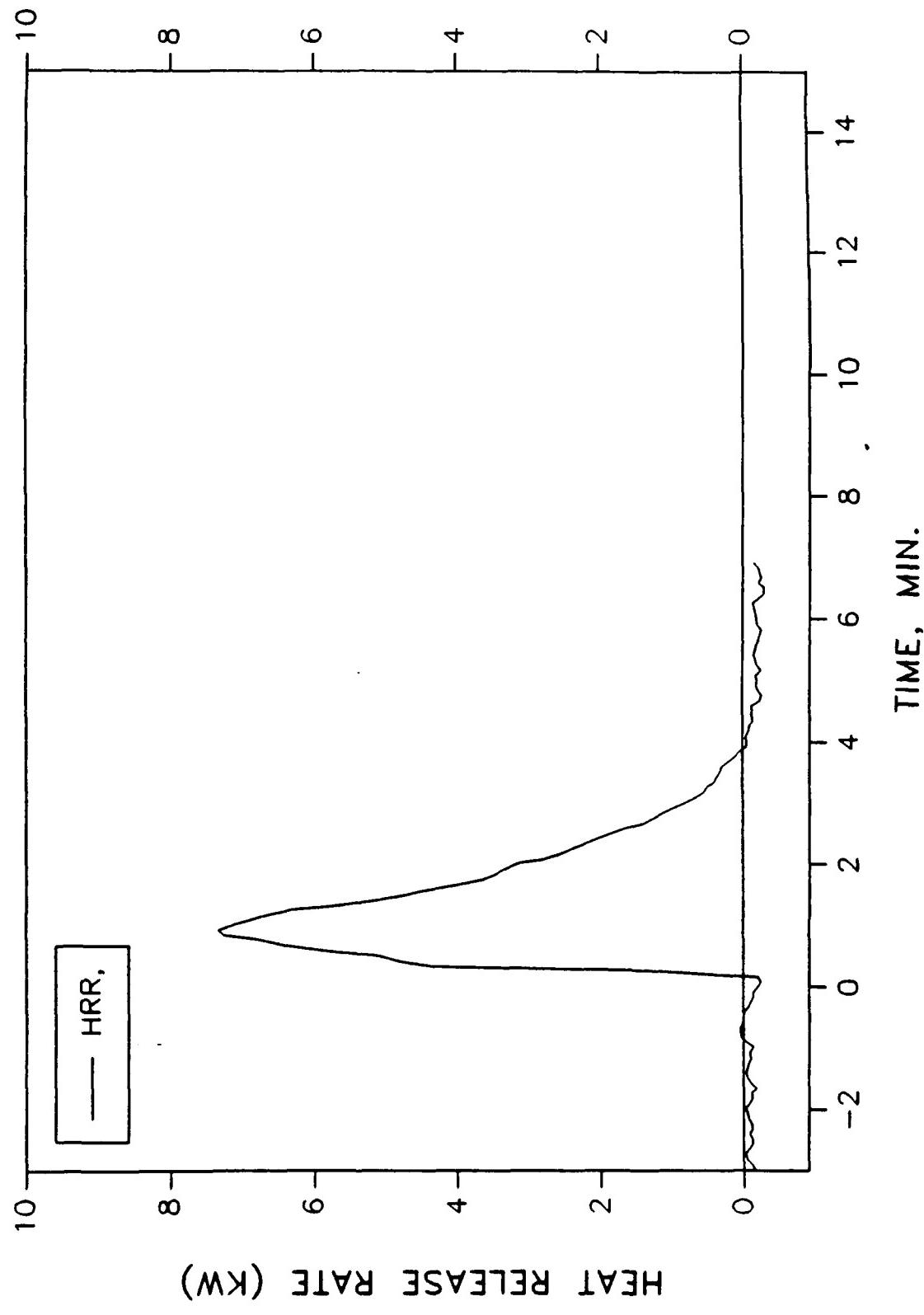
Summary Of Test Results

Sample	Time of					
	Maximum Flame Spread	Maximum Flame Spread	Critical Radiant Flux*	Total Heat Release	Maximum Heat Release	Test Duration
	(mm)	(s)	(W/cm <sup>2</sup> )	(KJ)	(KW)	(min:s)
A	470	204	1.14	818	7.3	7:00
B	250	253	3.72	494	2.6	7:10
C	250	49	3.72	519	3.2	9:00
D	490	238	0.98	912	7.7	8:00
E	310	50	2.97	109	3.1	4:00
F	310	190	2.97	575	6.2	8:30
G	330	215	2.72	885	7.6	9:00
H	310	110	2.97	793	7.4	8:30
I	300	327	3.10	359	2.7	10:00
J	210	145	4.18	180	2.2	6:00
K1	270	250	3.48	495	3.5	14:30
K2	300	336	3.10	455	2.6	13:00
K3	350	545	2.46	412	2.3	13:00
L1	320	72	2.84	167	3.2	7:00
L2	360	90	2.34	242	3.1	7:00

\* - Radiant flux based upon best fit polynomial equation of calibration values for distance vs. radiant flux.

HEAT RELEASE RATE VS TIME

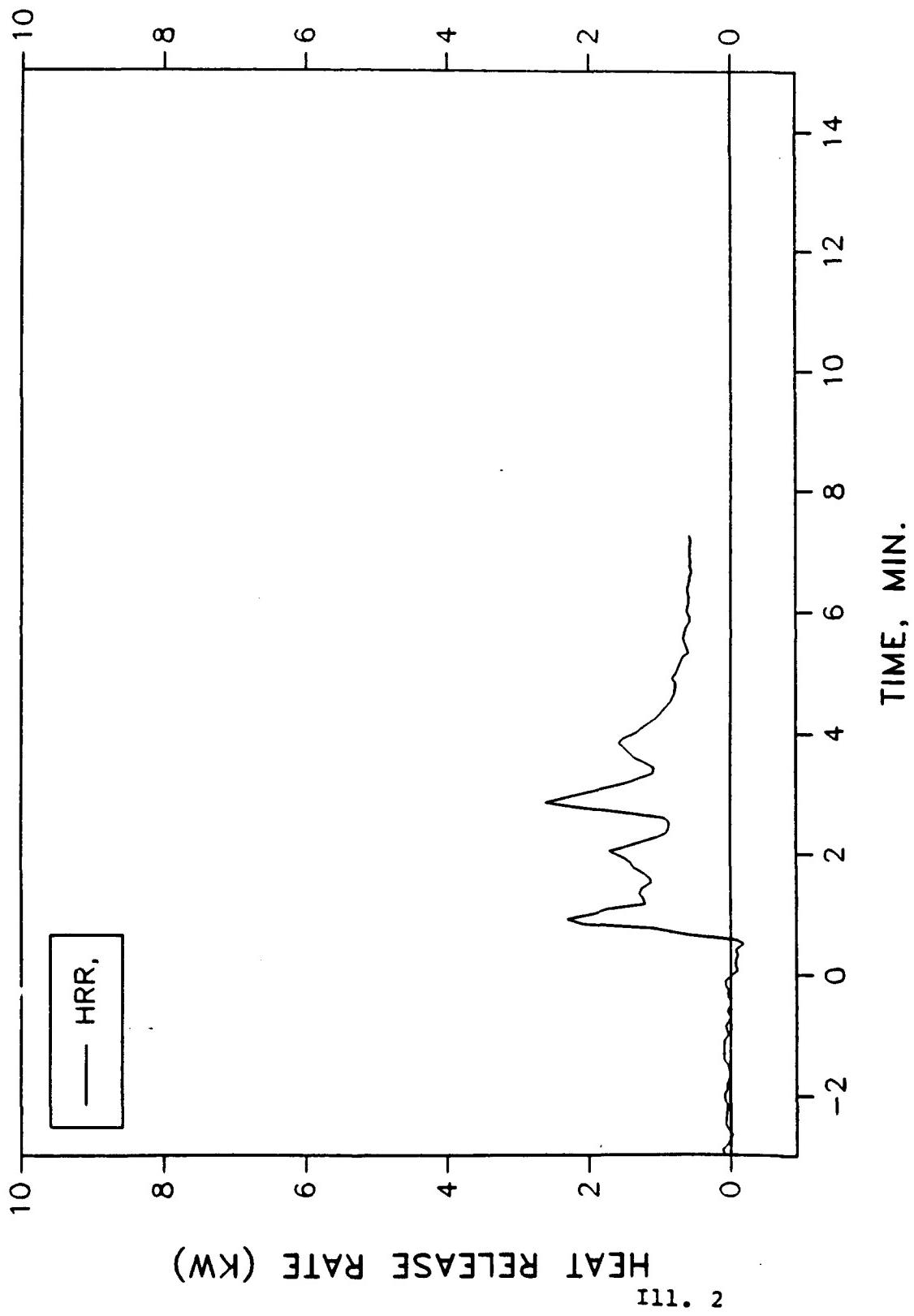
88NK11178/NC146      USCG-IMO TEST NO. 1



III. 1

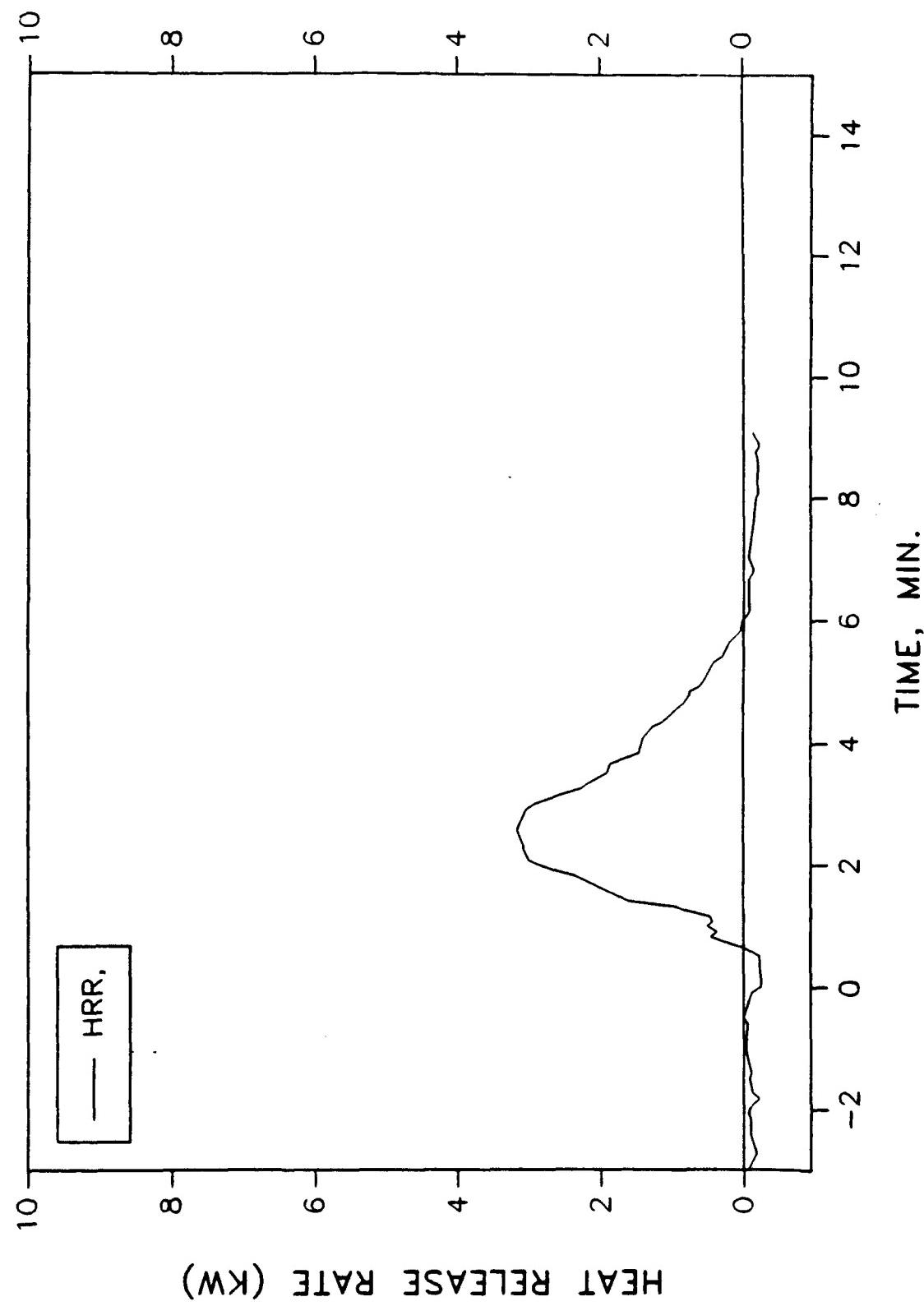
HEAT RELEASE RATE VS TIME

88NK11178/NC146      USCG-IMO TEST NO. 2



HEAT RELEASE RATE VS TIME

88NK11178/NC146      USCG-IMO TEST NO. 3

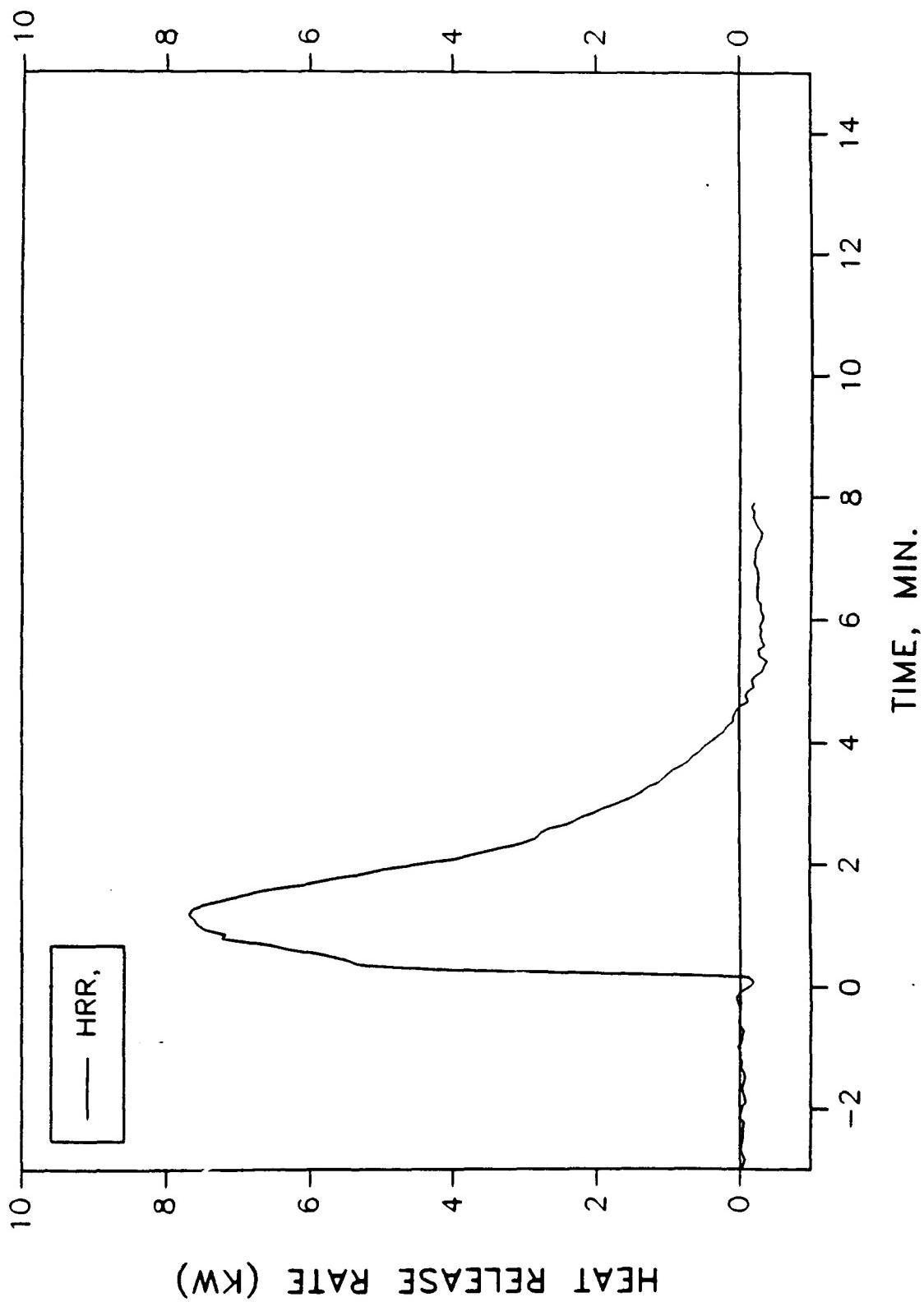


III. 3

HEAT RELEASE RATE VS TIME

88NK11178/NC1146

USCG-IMO TEST NO. 4



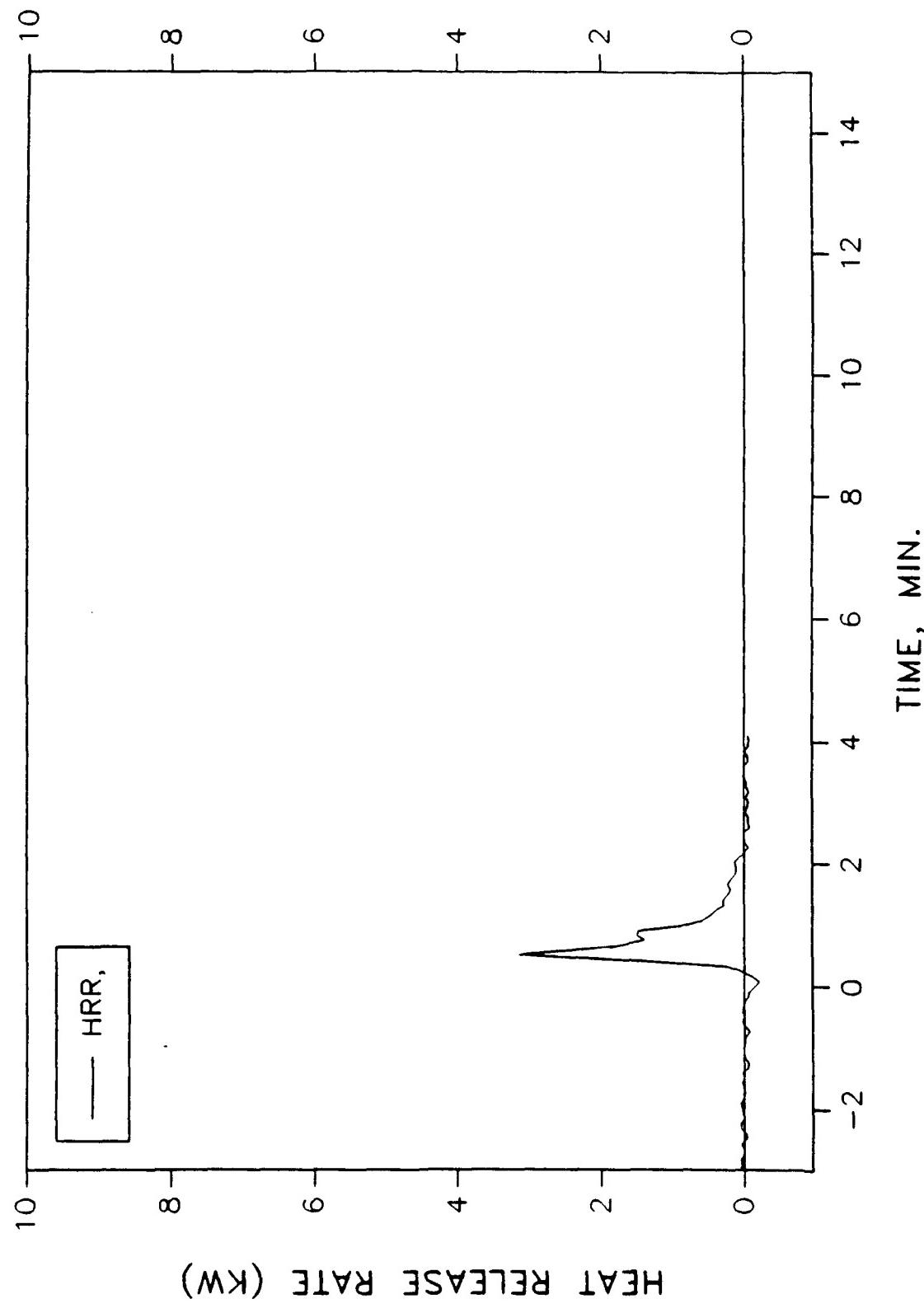
III. 4

D-14

88NK11178/NC146

HEAT RELEASE RATE VS TIME

USCG-IMO TEST NO. 5

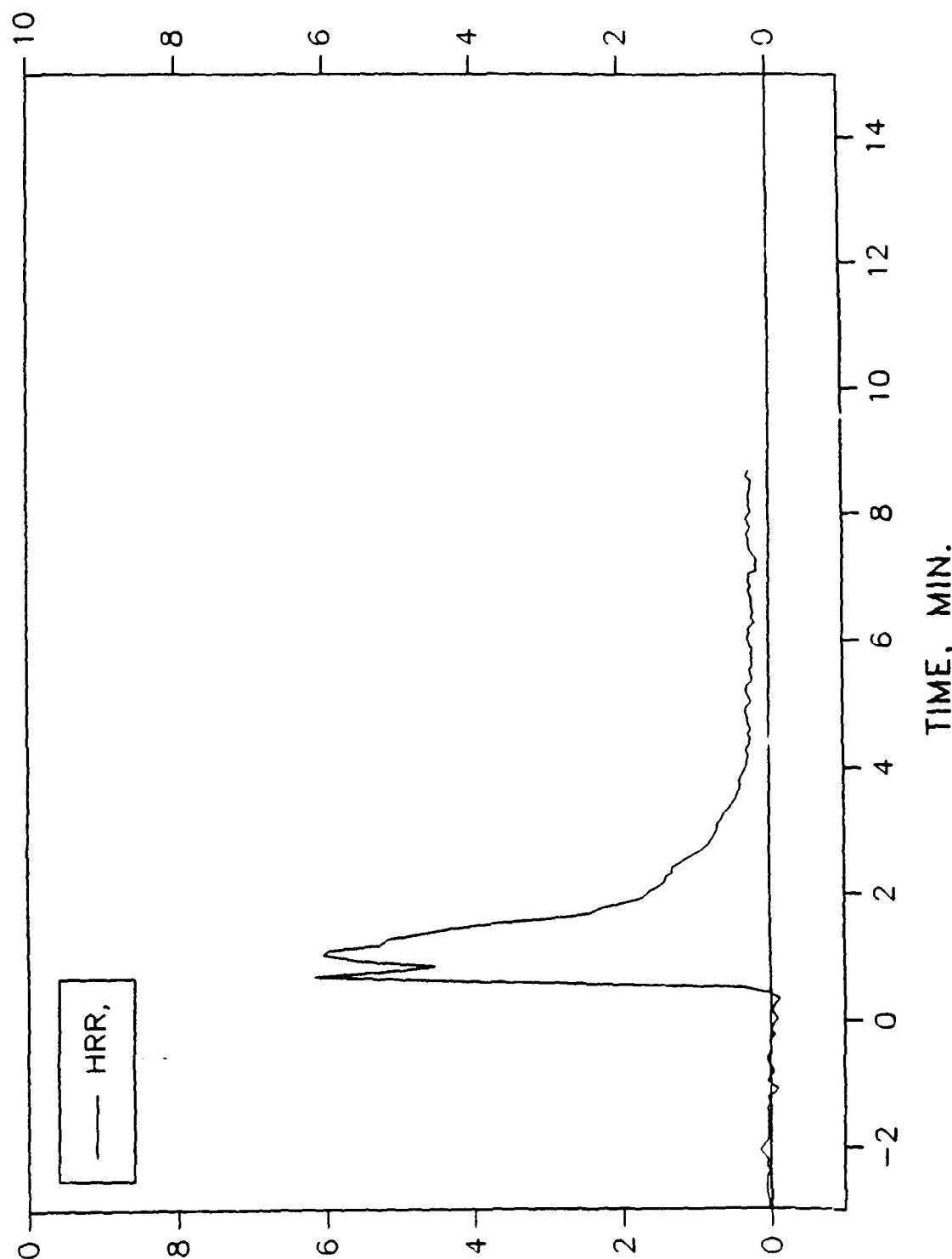


III. 5

HEAT RELEASE RATE VS TIME

88NK11178/NC146

USCG-IMO TEST NO. 6

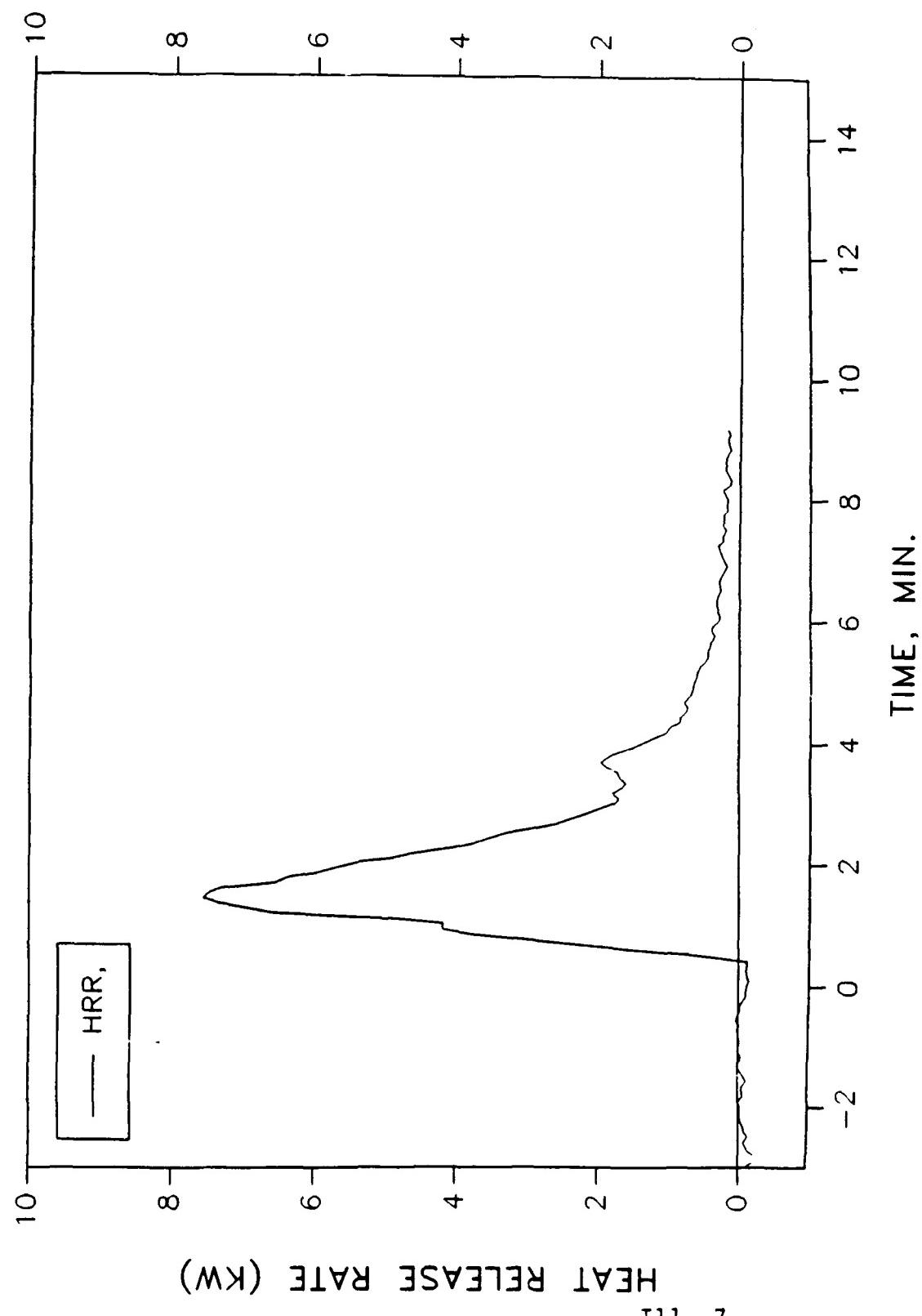


HEAT RELEASE RATE (kW)

III. 6

HEAT RELEASE RATE VS TIME

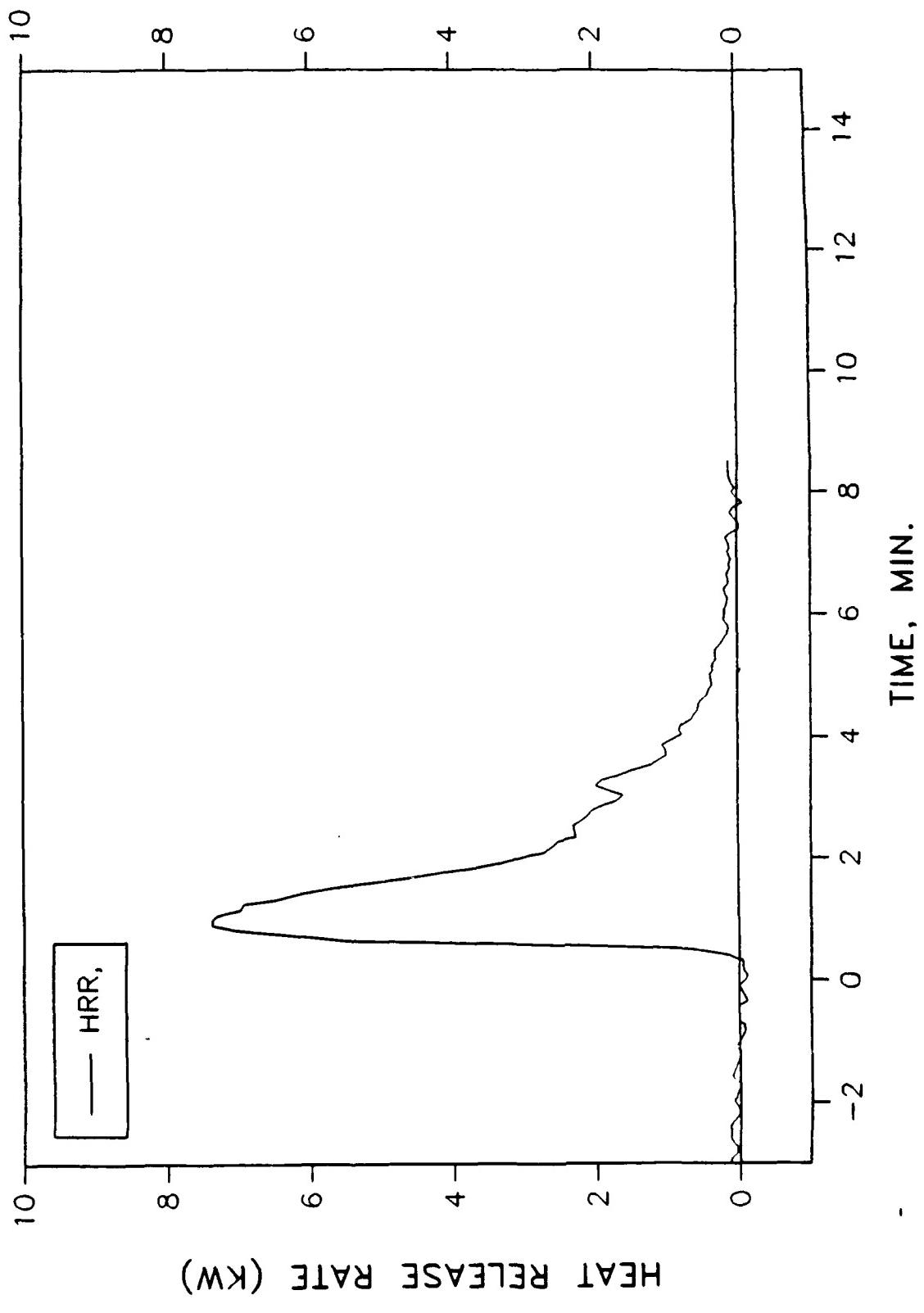
88NK11178/NC146      USCG-IMO TEST NO. 7



HEAT RELEASE RATE VS TIME

88NK11178/NC146

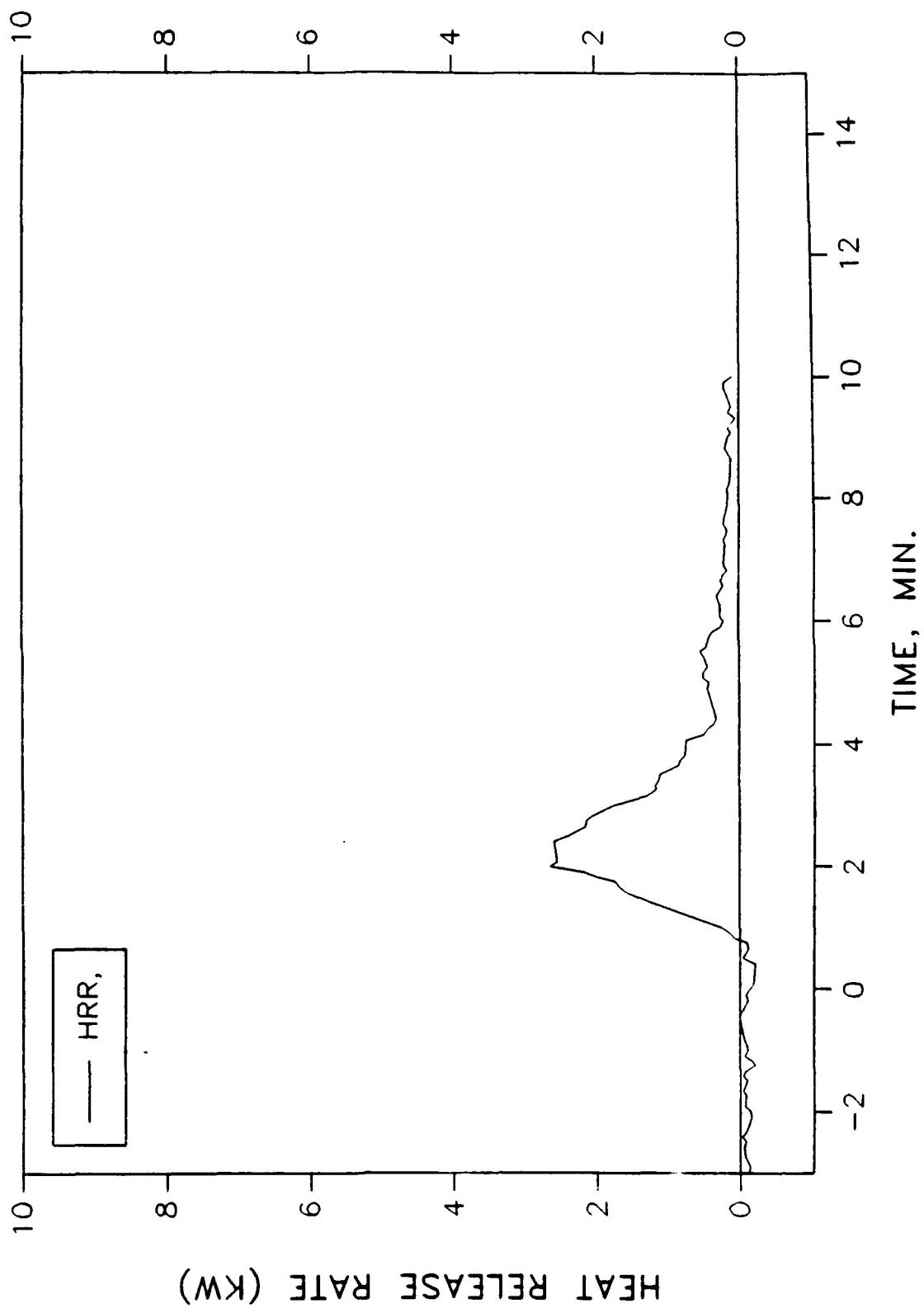
USCG-IMO TEST NO. 8



HEAT RELEASE RATE VS TIME

88NK11178/NC146

USCG-IMO TEST NO. 9



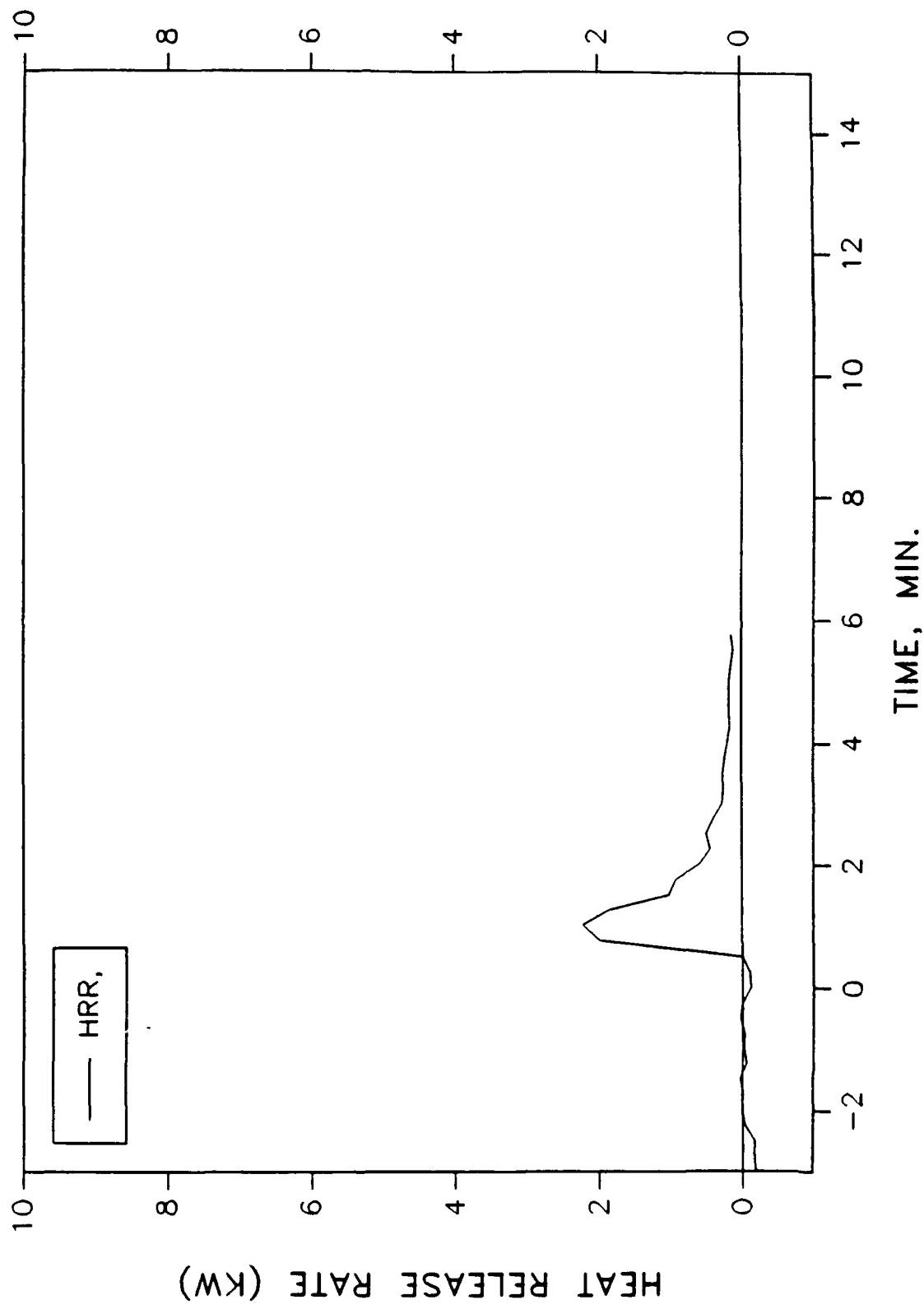
III. 9

D-19

HEAT RELEASE RATE VS TIME

88NK11178/NC146

USCG-IMO TEST NO. 10

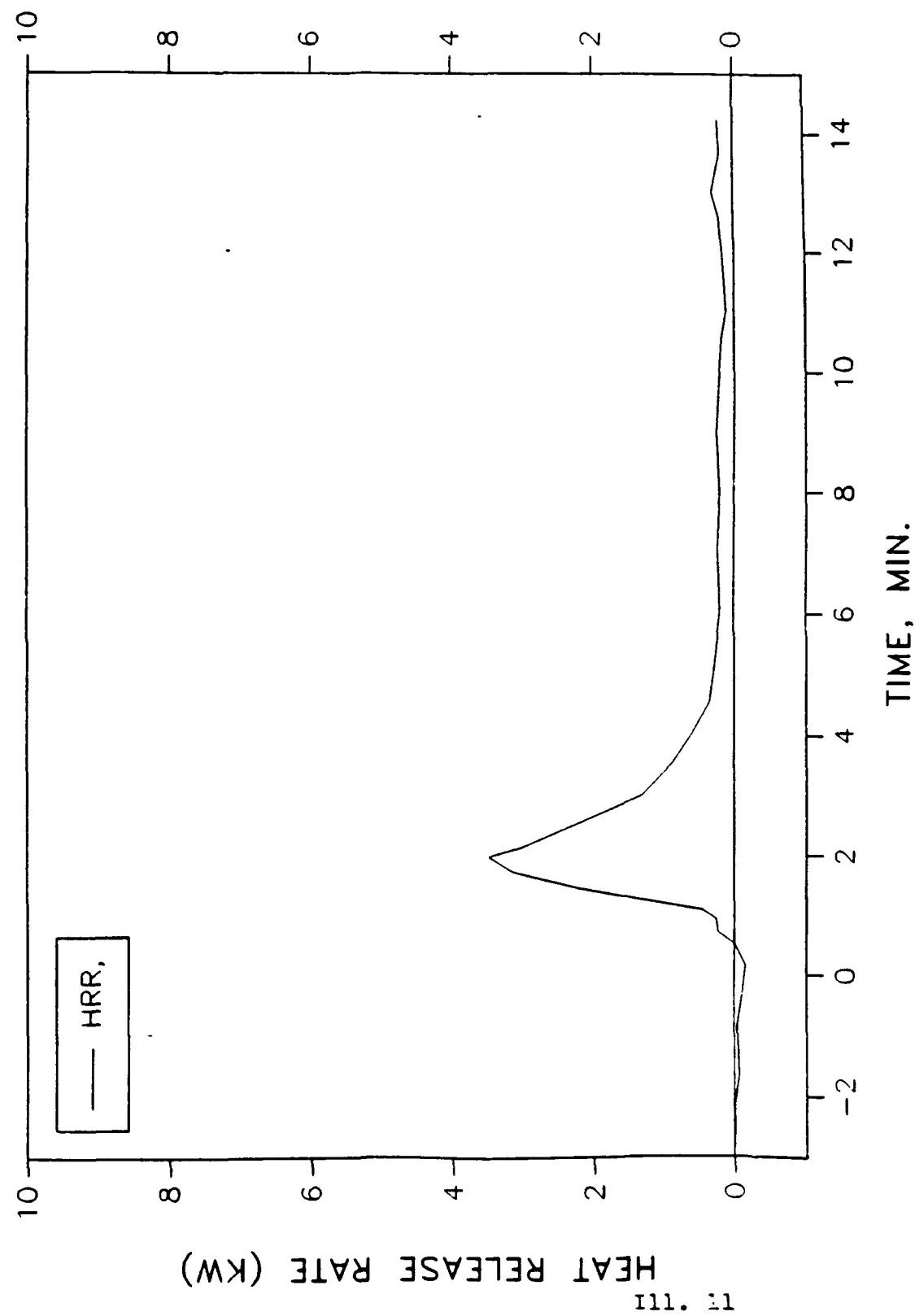


HEAT RELEASE RATE (kW)

ILL. 10

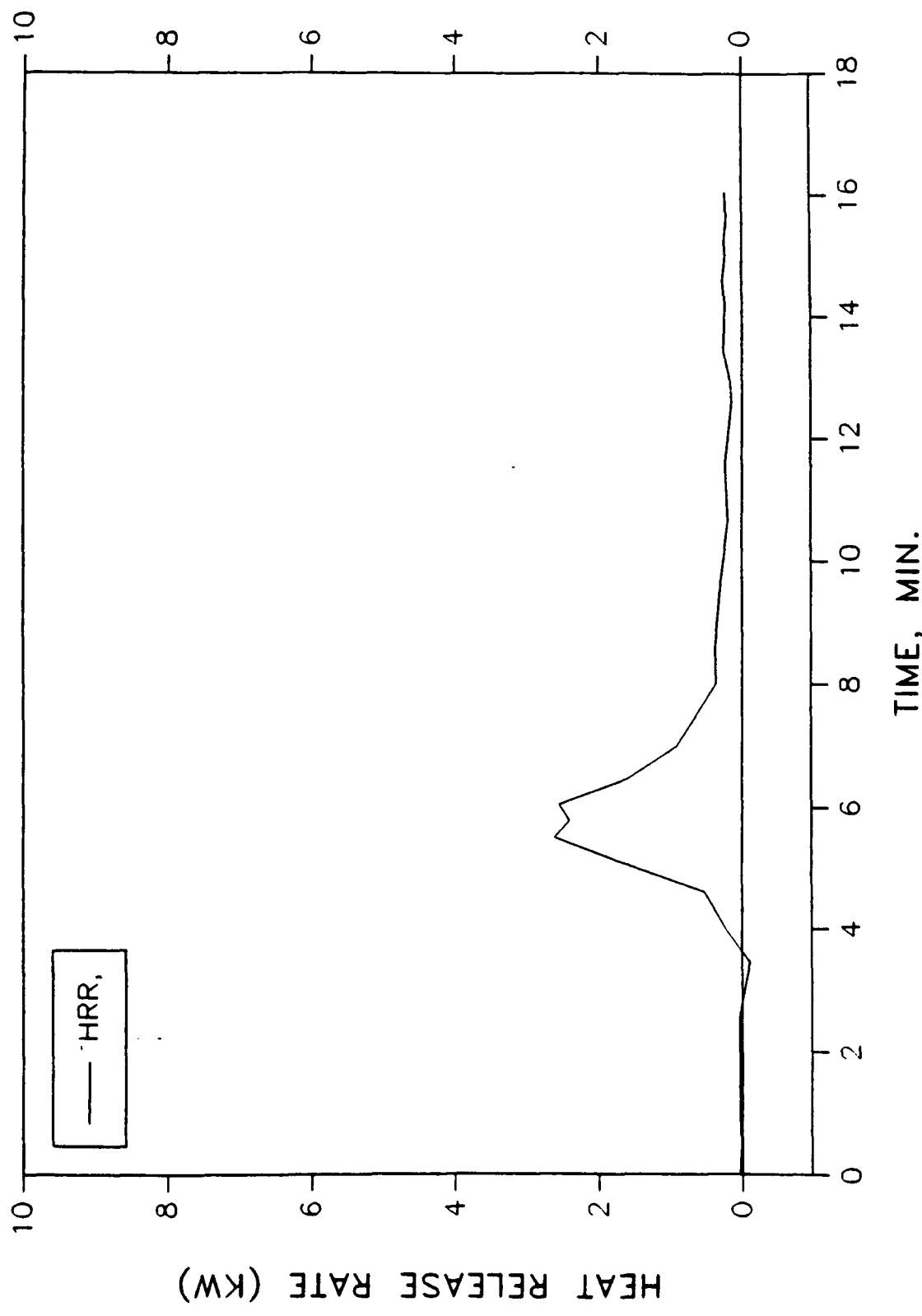
HEAT RELEASE RATE VS TIME

88NK11178/NC146      USCG-IMO TEST NO. 11



HEAT RELEASE RATE VS TIME

USCG-IMO TEST NO. 12  
88NK1178/NC146

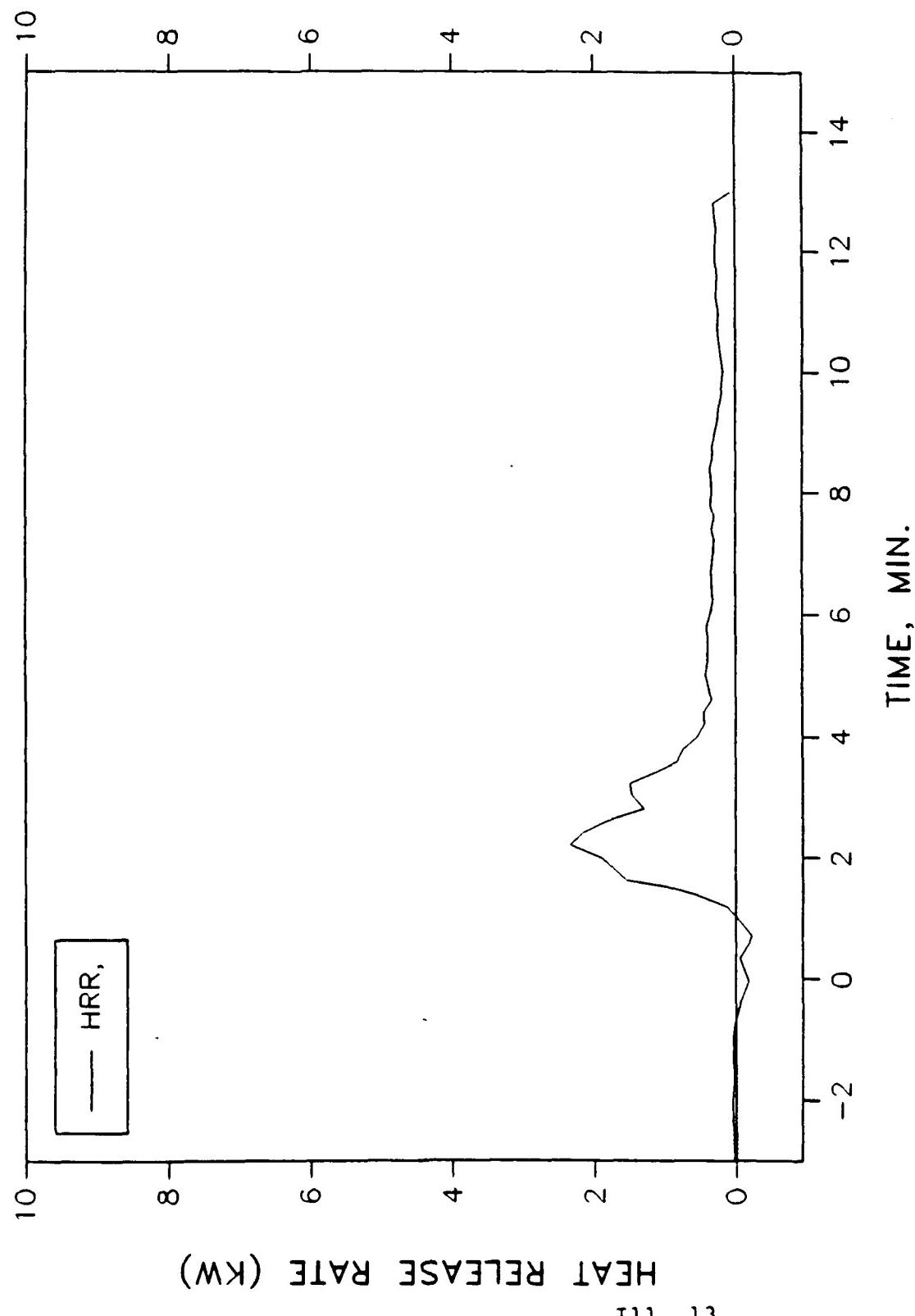


HEAT RELEASE RATE (kW)

III. 12

HEAT RELEASE RATE VS TIME

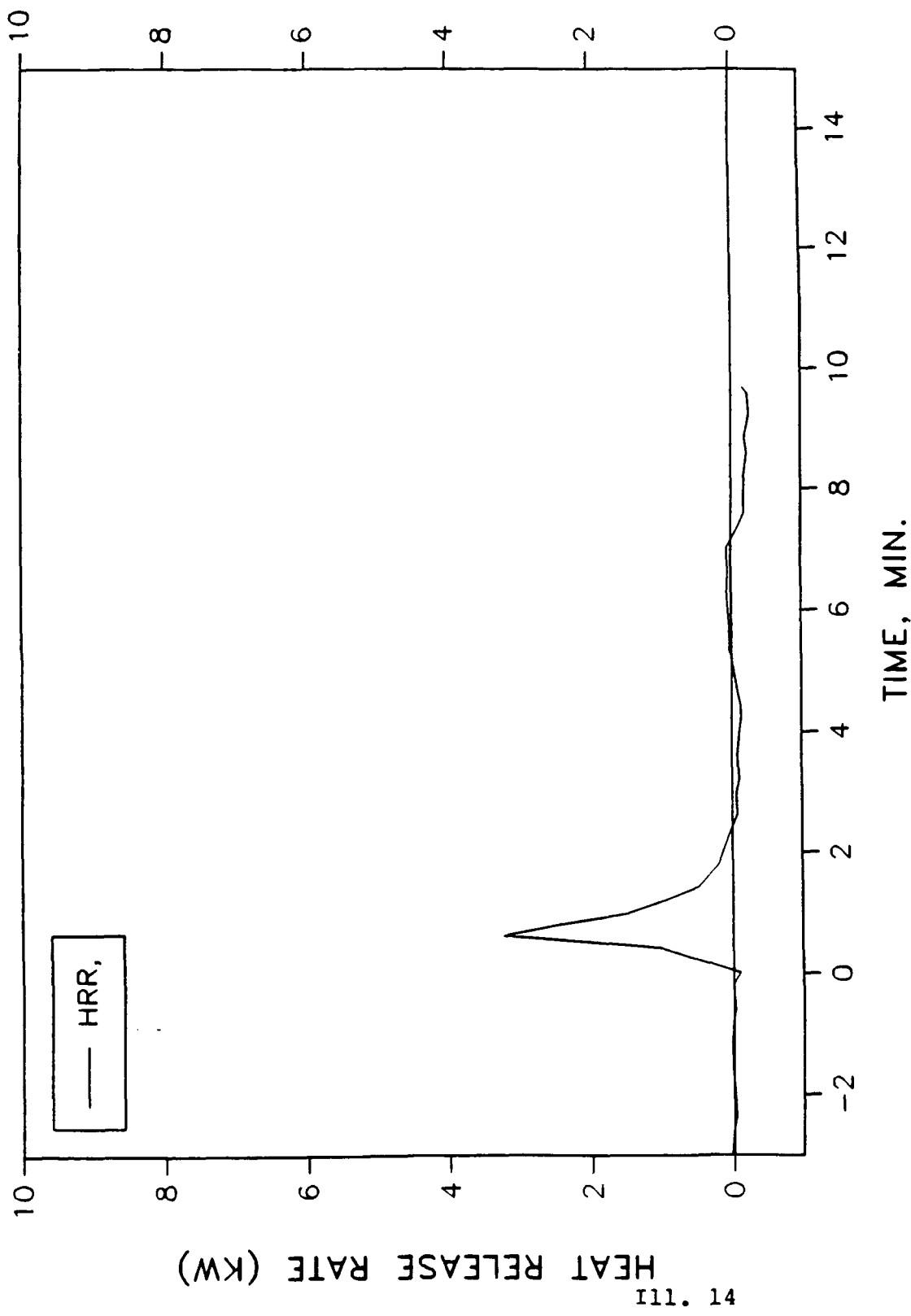
88NKK11178/NC146      USCG-IMO TEST NO. 13



111.13

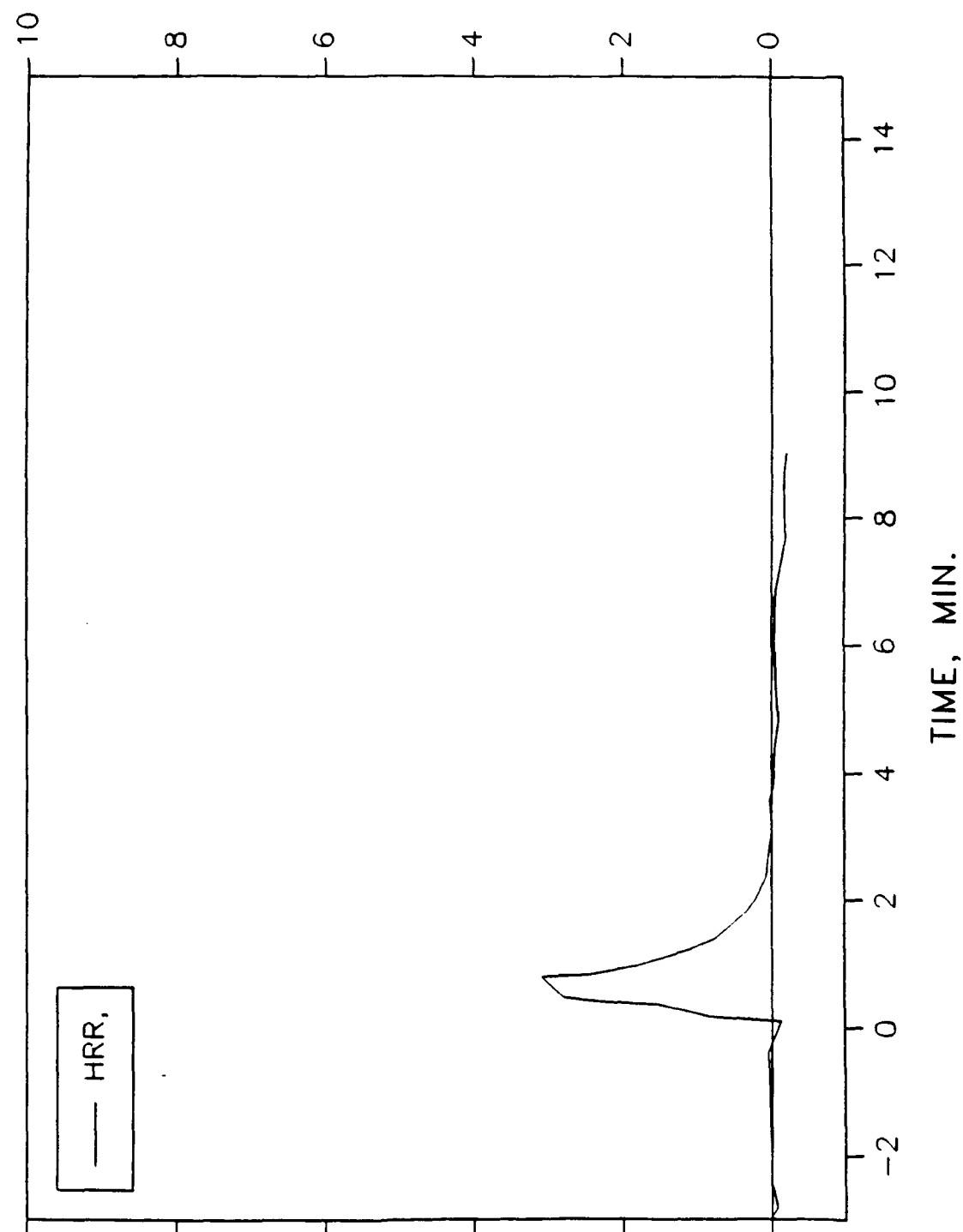
HEAT RELEASE RATE VS TIME

88NK11178/NC146      USCG-IMO TEST NO. 14



HEAT RELEASE RATE VS TIME

88NK11178/NC146      USCG-IMO TEST NO. 15



HEAT RELEASE RATE (kW)

III. 15

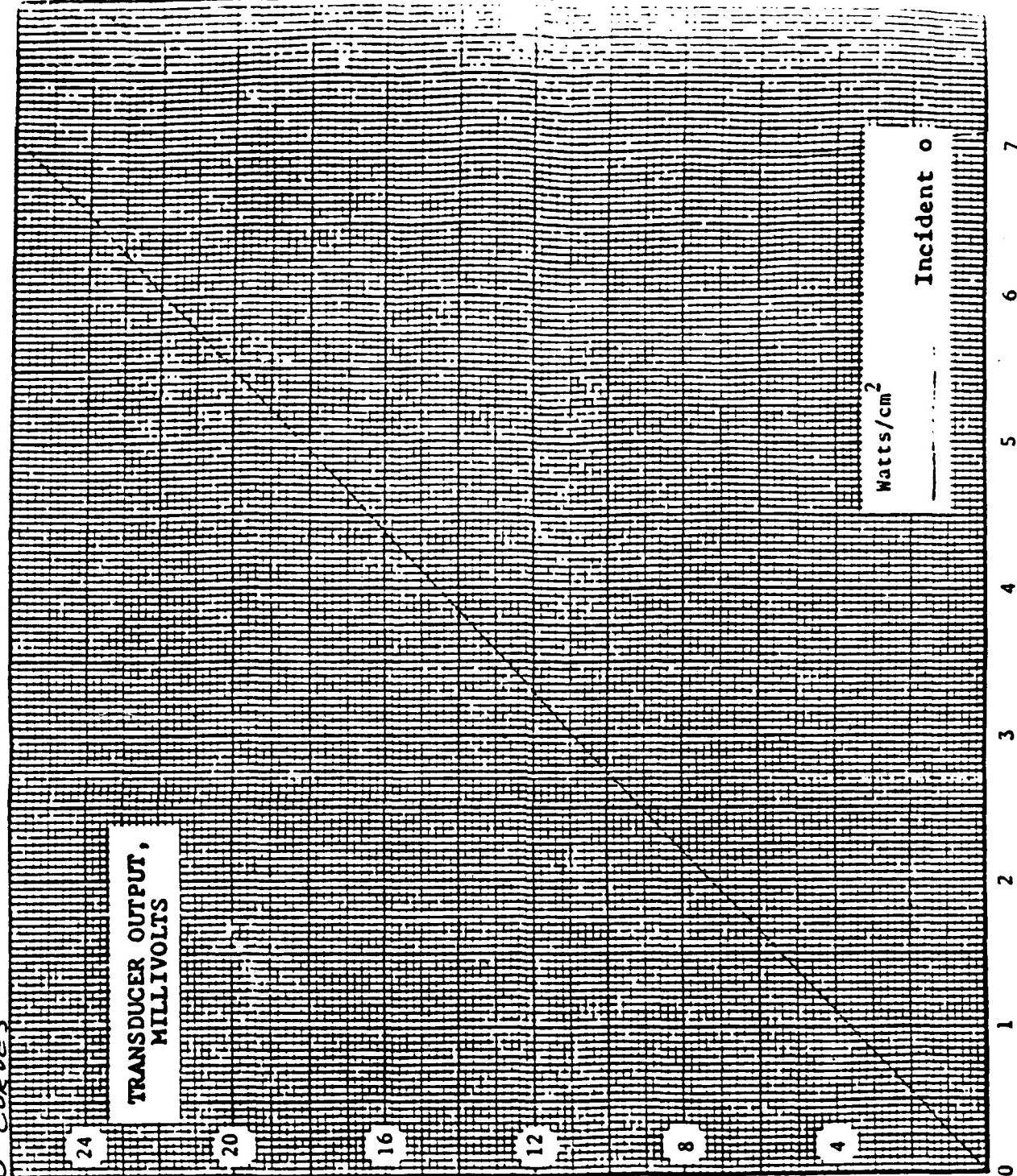
File USNC 146

A P P E N D I X A \*

CALIBRATION CURVES OF MILLIVOLTS VS. WATTS  
FOR RADIOMETERS

\* APPENDIX A of Underwriters Laboratories, Inc., File USNC 146, 88NK1178  
under U.S. Coast Guard Contract DTG23-88-A-01026

## 5.4.1 CALIBRATION CURVES

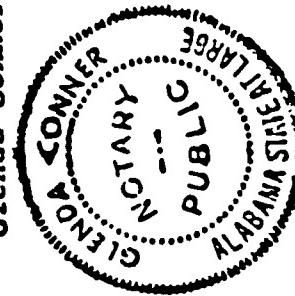
CERTIFICATE  
OF  
CALIBRATIONTRANSDUCER OUTPUT,  
MILLIVOLTS

DATE 7/15/86  
 CUSTOMER Iofftron Corp.  
 CUSTOMER P.O. 107103-A

MODEL NO. 64-3-20  
 SERIAL NO. 1214831  
 ABSORPTIVITY 0.97  
 WINDOW TYPE None

REFERENCE STANDARD 325732  
 TESTED BY FB  
 QC ACCEPTANCE McNICHOLS TEST  
INSPECT

CERTIFIED CALIBRATION  
 NO. 2  
 SUBSCRIBED AND SWEORN TO  
 BEFORE ME THIS 15th DAY  
 OF July 1986  
Glenda Conner



ILL. A1

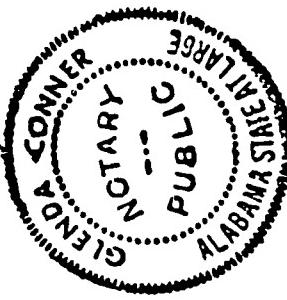
**CERTIFICATE  
OF  
CALIBRATION**

DATE 7/15/86  
CUSTOMER Lofton Corp.  
CUSTOMER P.O. 107103-A

MODEL NO. 64-3-20  
SERIAL NO. 1214837  
ABSORPTIVITY 0.97  
WINDOW TYPE None

REFERENCE STANDARD 325732  
TESTED BY QC ACCEPTANCE  
TEST INSPECT

CERTIFIED CALIBRATION  
SUBSCRIBED AND SWEORN TO  
BEFORE ME THIS 15th DAY  
OF July 1986  
*M. Linda Conner*  
M. Linda Conner



ILL. A2

TRANSDUCER OUTPUT,  
MILLIVOLTS

24

20

16

12

8

4

0

Watts/cm<sup>2</sup>

Incident o

**INCIDENT FORM  
CORPORATION**

**HEAT FLUX**

U.L. POST OFFICE BOX 412 / HUNTSVILLE, ALABAMA 35804 / TELEPHONE (205) 831-1111

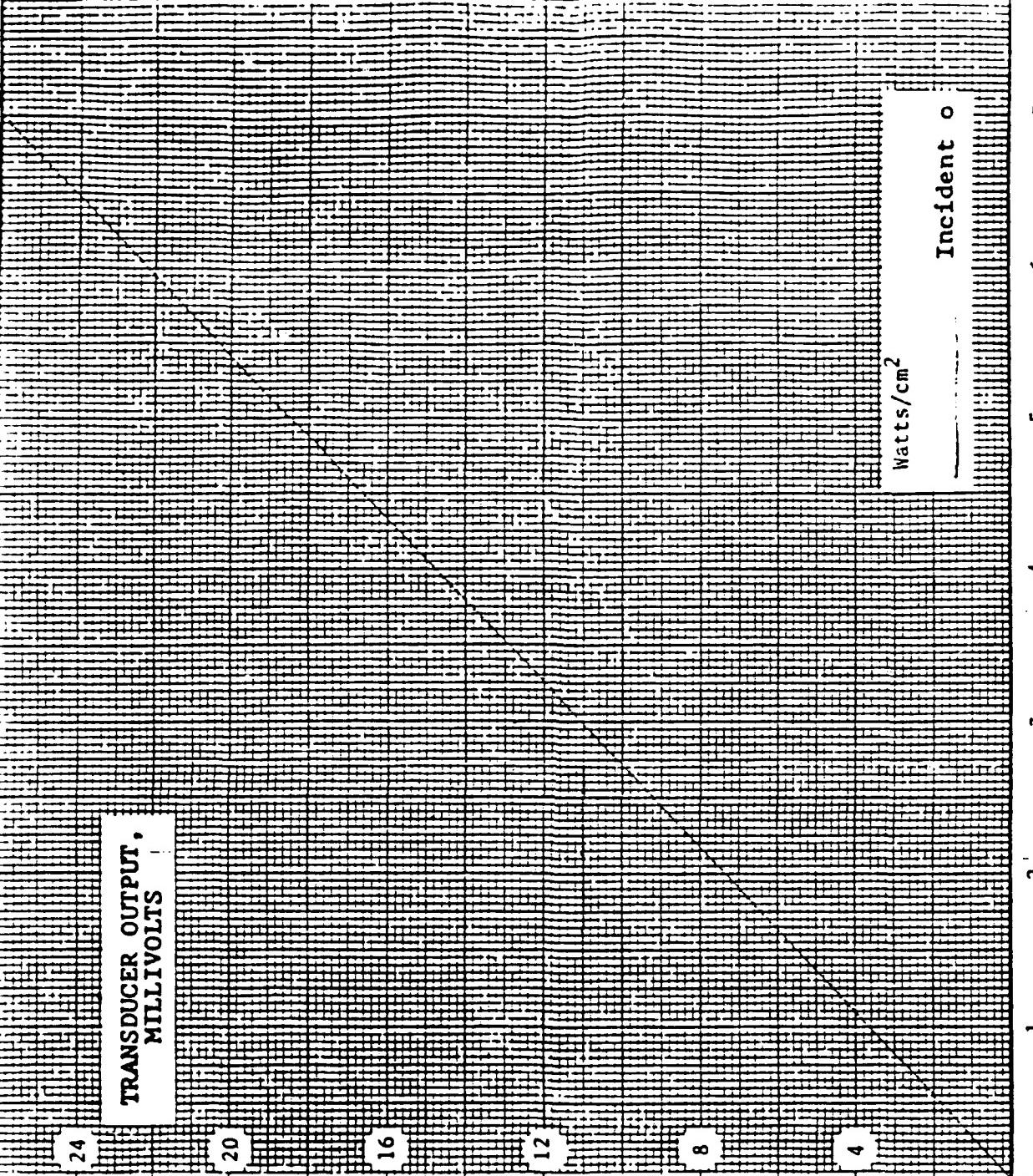
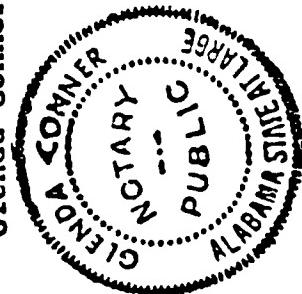
**CERTIFICATE  
OF  
CALIBRATION**

DATE 7/15/86  
CUSTOMER Lofton Corp.  
P.O. #07103-A  
MODEL NO. 64-3-20  
SERIAL NO. 823838  
ABSORPTIVITY 0.97  
WINDOW TYPE None

REFERENCE STANDARD 325732  
TESTED BY FR  
QC ACCEPTANCE  TEST  
 INSPECT

CERTIFIED CALIBRATION  
SUBSCRIBED AND SWORN TO  
BEFORE ME THIS 15th DAY  
OF July 1986  
Glenda Conner  
Glenda Conner

**ILL. A3**



**MEDITETERM  
CORPORATION**

U.L. — POST OFFICE BOX 412 / HUNTSVILLE, ALABAMA 35804 / TELEPHONE (205) 837-

**HEAT FLUX**